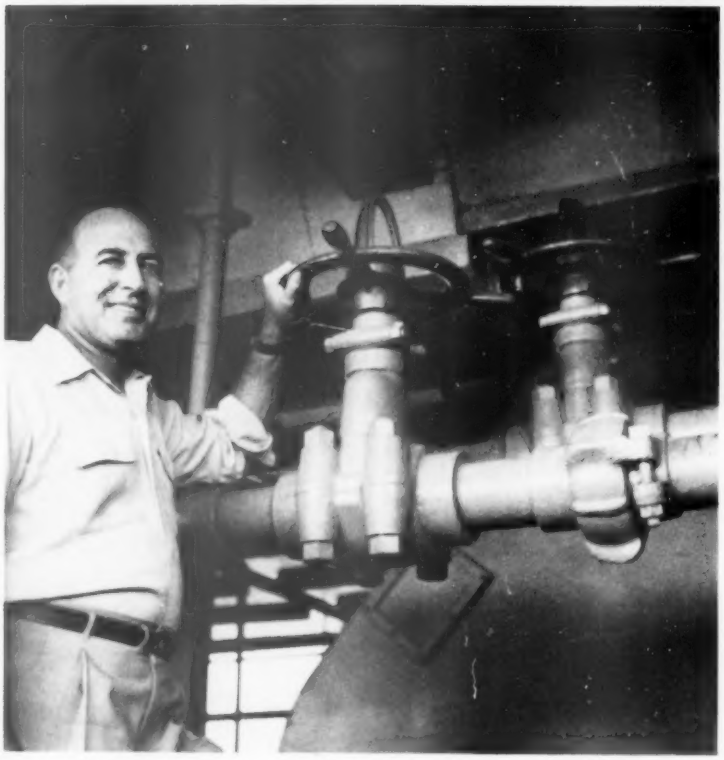
the A.P.I. NUMBER
OIL AND GAS
JOURNAL

• Standard equipment, the world over . . . Cameron Flex-Seal Valves, Pressure Gauge, and Shear-Relief Valve in a mud line manifold.

• Cameron Pressure Gauge . . . accurate, easy-to-read mud line pressure.

• Cameron Shear-Relief Valve . . . positive protection against excessive pump pressures.



J. B. Ray, Cameron's Division Sales Manager, South Texas Division

MUD LINE LOGIC

These Cameron Products have proved that mud line costs can be cut—

Cameron Flex-Seal Valves have a resilient and renewable flow-way insert which absorbs the cutting action of the muds. If worn out after long service, this insert may be replaced quickly and economically at the rig.

Cameron Pressure Gauges have proved so superior for mud line service that most rotary rigs are equipped with them exclusively.

Cameron Shear-Relief Valves, by shearing a common nail when mud line pressures soar, protect pumps and the entire mud system.

Cameron
IRON WORKS, INC.
P. O. BOX 1212, HOUSTON, TEXAS

Export Office: 7912 Empire State Bldg., New York City • In England: British Oilfield Equipment Co., Ltd., Duke's Court, St. James's, London, S.W. 1, England

PRICE 50 CENTS TABLE OF CONTENTS ON PAGE 1 NOVEMBER 16, 1953

Features you will like in —

ROCKWELL "201" ORIFICE METERS

LEAKPROOF STUFFING BOX

Has combination bearing and packing made of Teflon. All other parts are of stainless steel. The higher the pressure the tighter the seal, yet Teflon seals without binding and requires no maintenance.

INTERCHANGEABLE HIGH SIDE CHAMBERS

The unit manometer construction permits you to interchange high side chambers easily and adapt any range meter to higher or lower differential requirements. This construction saves stocking spare meters.

ROCKWELL CHART DRIVE

Hermetically sealed. Runs 8 days with one winding. Chart arbor turns once in 24 hours. Turret converters permit chart rotation rate to be changed at will.

STAINLESS PEN ARMS— MICROMETER ADJUSTMENT

The corrosion resistant pen arms are painted different colors for ready identification. A simple micrometer adjustment is provided for zero setting.

SERVICE CONVENIENCE

Your field men appreciate the extra strong construction—the simplified arrangement of parts—the clean records left by the positive inking pens —the ease with which the meter can be serviced with ordinary tools.

Write for bulletin 1050

Battery of six Rockwell orifice meters measuring gas served to compressors in gasoline plant.

THE ROCKWELL INTEGRATOR

Mechanically calculates up to 300 average charts a day with instrument accurate precision. Produces a verified record of results. Accuracy to within ½ of 1 per cent is practical. Described in bulletin 1016.

ROCKWELL

You Can RELY ON ROCKWELL

The OIL AND GAS JOURNAL

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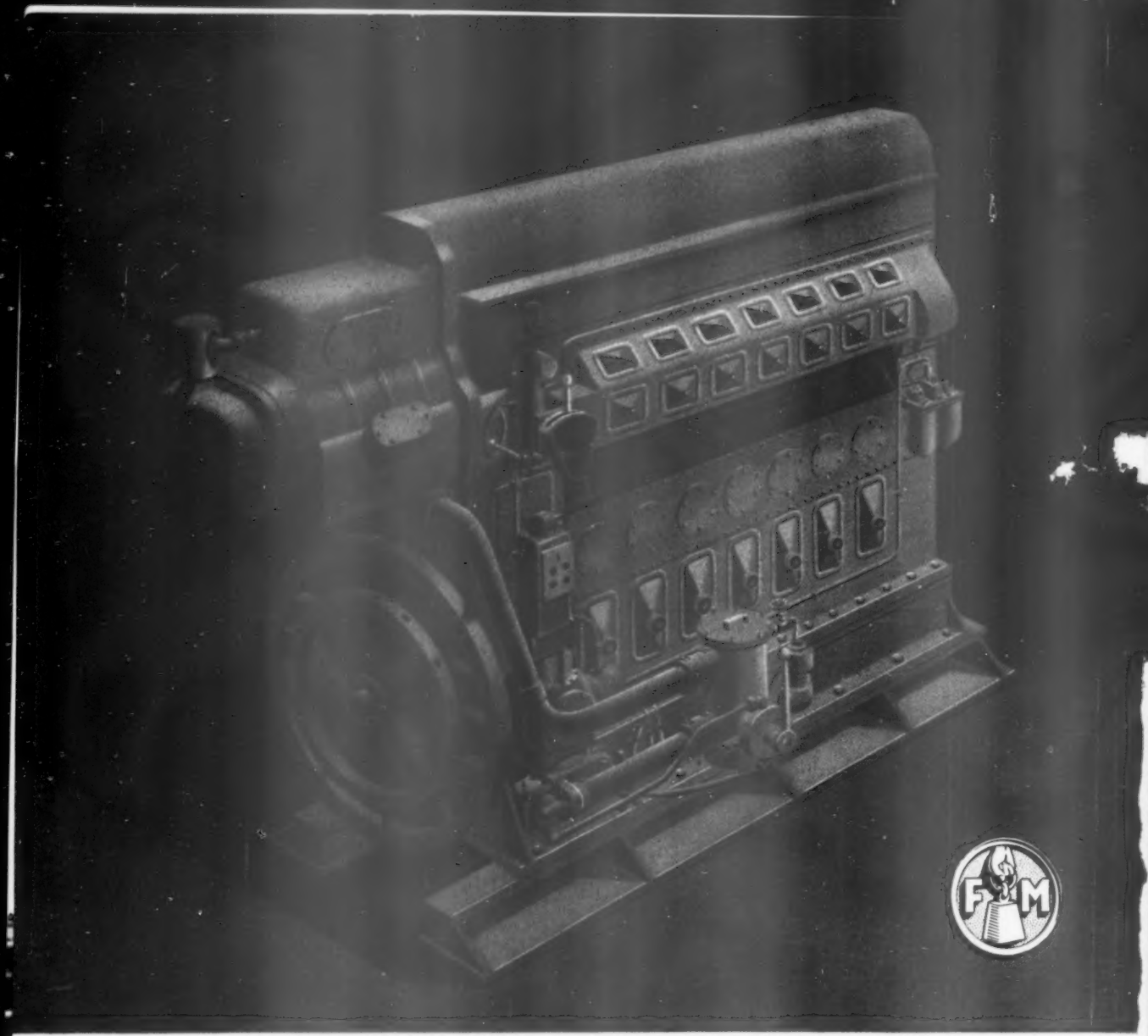
In Brief . . .

This big A.P.I. number contains 14 pages of spot news coverage, with pictures, of the world's biggest oil meeting. Five members of the editorial staff, along with a number of other Journal employes, were at the meeting to provide full coverage.

Included in the A.P.I. section are texts of 18 papers presented at the meeting. These articles cover thoroughly the various branches of the oil industry. Also included are three progress reports on the A.P.I. fundamental research programs.

One of the biggest problems facing refiners now is the handling of the bottom-of-the-barrel fractions. Two continuous-coking processes are being developed for economically processing these heavy materials. Up-to-the-minute reports on these processes are in the A.P.I. section.

Guides to future oil traps are being established in A.P.I. Project 51. It is now possible to recognize many depositional environments in ancient sediments. Results of this work have a particular application to the finding of ancient shore lines.



The Fairbanks-Morse Opposed Piston Diesel Model 38F 90. 225 to 750 horsepower.
Diesel Dual Fuel and Spark-ignition options.
Other O-P engines available in horsepower ratings to 2400.

. . . the price is more but the cost is less

You can buy many diesels for a little less than this Fairbanks-Morse OPPOSED PISTON Diesel . . . but no engine working at rated load can deliver power more reliably at less cost. The slightly higher price is quickly offset by the freedom from maintenance and service interruptions.

More engine hours of unfailing service mean fewer man-hours in maintenance and repair.

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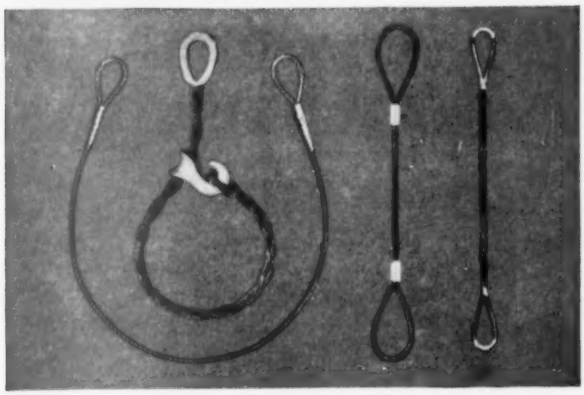
Wire Rope

for cranes, hoists, elevators, and all equipment

From Macwhyte's complete line of a thousand and one sizes and types, you get the right rope for your equipment. Thoroughly lubricated, PREformed, engineered to give long, low-cost service. *Send for Catalog G-15.*



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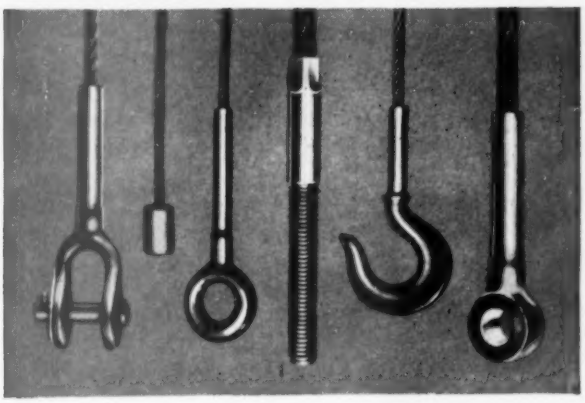
Slings

for lifting and moving materials, equipment in production or maintenance

There are hundreds of types and sizes of Macwhyte Round-Braided, Flat-Braided, Single-Part, and Grommet Slings. All are custom made in length, capacity, and flexibility to meet your needs. *Send for Catalog S-8.*



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for machine parts, controls, and operating devices

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Looking for economical, 24-hour-a-day pumping power?

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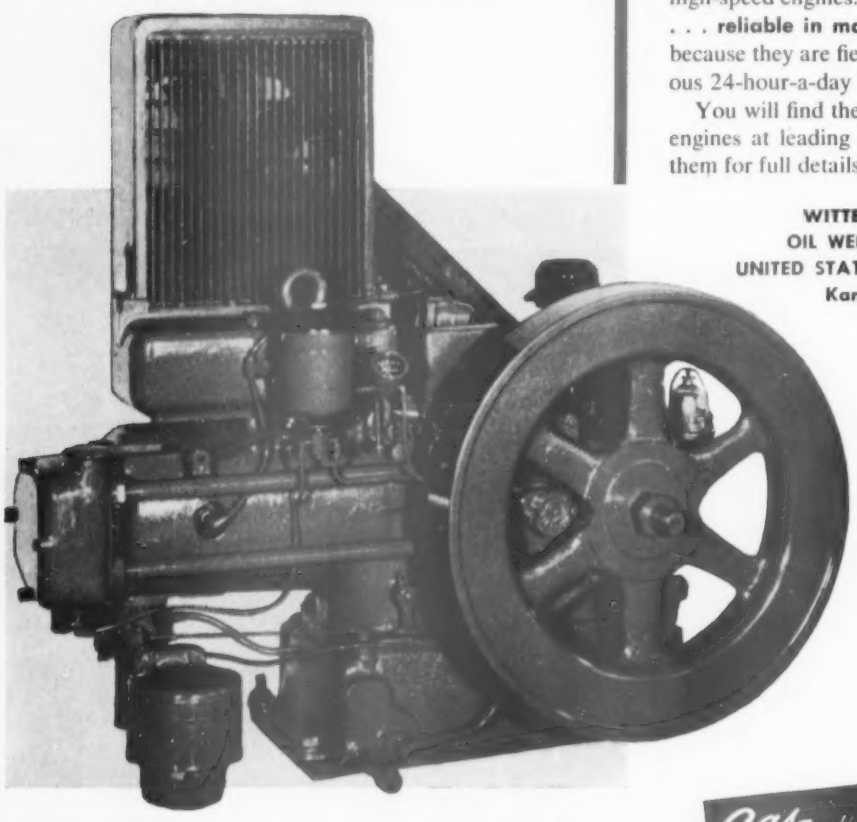

• When natural gas fuel is available, production men think first of Witte Gas Engines for economical power . . .

. . . **economical in low maintenance costs,** because they are Witte-built single cylinder, condenser cooled engines, with a medium operating speed which assures longer service life as compared to high-speed engines.

. . . **reliable in maintaining pumping schedules,** because they are field proven and built for continuous 24-hour-a-day operation.

You will find the complete line of Witte oil field engines at leading oil field supply stores . . . ask them for full details or write for booklet No. W-21.

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Gas-gasoline Models from 4 to 15.5 hp

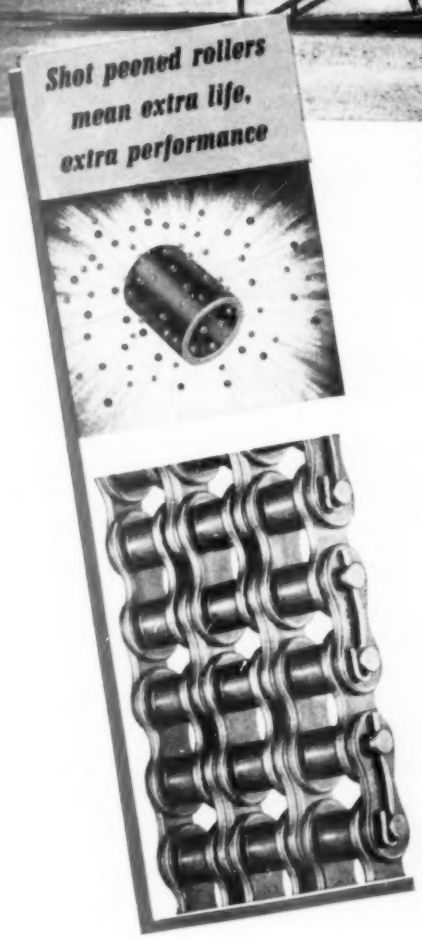
Full diesel models from 3.75 to 12.5 hp

UNITED STATES STEEL

The Oil and Gas Journal, published Mondays, copyright 1953, by The Petroleum Publishing Company. Entered as second-class matter September 1, 1910, at post office at Tulsa, Okla., under act of March 3, 1879. U. S. and foreign rates to the petroleum industry, $4 yearly.

Mobile Rig with Link-Belt Roller Chain -- Ready to go . . . *Anywhere*

Shown above is one of the new National Supply Company Trailer Mounted Well Service and Drilling Rigs, assembled in *National's Houston, Texas plant*. The rig above was purchased by *Earl Carlton, Drilling Contractor.*



THIS National rig, fully equipped with Link-Belt Precision Steel Roller Chain, is an especially compact and versatile unit for servicing jobs in the 3000- to 6000-foot range and for drilling jobs in the 1500- to 3000-foot range. It is rated at 120 input h.p., through a torque converter drive. The Link-Belt Roller Chain equipped transmission provides two forward speeds to the drum and rotary table, and a mechanical reverse is optional.

Such factors as shot peened rollers to lengthen chain life, controlled heat treatment for uniform strength and careful manufacture to precise dimensions are some of the reasons why Link-Belt Precision Steel Roller Chain is used.

Call in your nearest Link-Belt Sales Representative. He'll be glad to show you how extra performance and endurance can be designed into your product by specifying, "Link-Belt, all the way through."

LINK-BELT

PRECISION STEEL ROLLER CHAIN

LINK-BELT COMPANY: Indianapolis 6, Houston 1, Dallas 1, Los Angeles 33, Scarboro (Toronto 13); Export Office, New York 7.

The thousand-mile handshake

When a company-owned Beechcraft Executive Transport is available for instant action, you and your key men find time to shake hands with field men, customers, new business prospects *regularly*. For example, you can leave at *your* convenience, cruise in relaxing comfort one thousand miles in less than five hours, tend to business, return that day. Home office work *can't* pile up.

Thousands of executives use this soundproofed Beech "Twin" in just such fashion daily. In *your* business, you could use more *time*. Investigate! Typical costs and operating data on request.

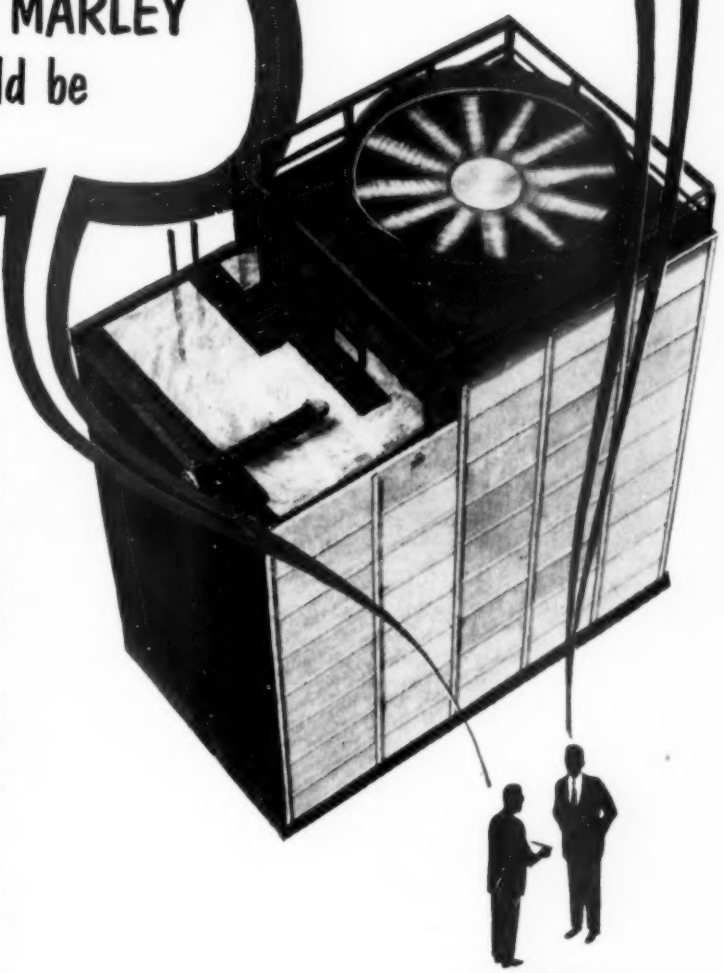
☆ ☆ ☆

Call your Beechcraft distributor or write Beech Aircraft Corporation, Wichita, Kansas, U.S.A.

BEECHCRAFTS ARE THE AIR FLEET OF AMERICAN BUSINESS

What's the temperature of the basin water?

84°— just what MARLEY said it would be



Thermal control dictates the economy of every process operation, and the key to control is cold water — delivered consistently at design specification. Every Marley cooling tower offered today will produce that optimum result.

Built into every Marley tower is the pretested performance ability to do its specified job (or more) day-after-day, year-in-year-out. This is the result of 30 years of constant research and development; the result of 10,000 separate installations of Marley mechanical draft cooling towers. Today Marley has positive performance data of every tower for any location and Marley backs its knowledge with an equally positive guarantee.

Test after test have proved the efficiency of Marley rating methods. These tests have been conducted according to procedure specified by all accepted test codes. The Marley tower you purchase is subject to the same complete test after installation.

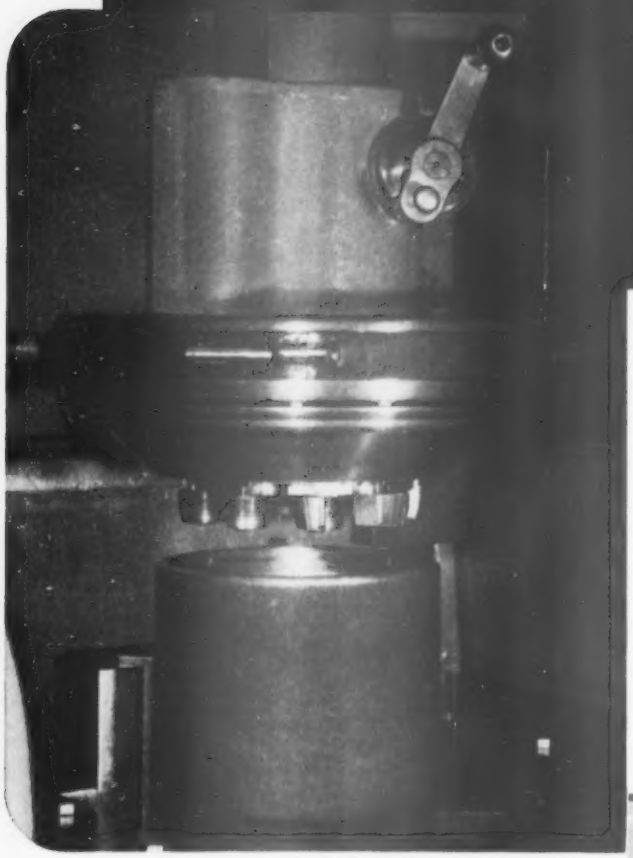
"Calculating Cooling Tower Performance from Test Data," a new Marley brochure explaining a simplified method of analyzing the actual performance of any type mechanical draft cooling tower will be available soon. May we have your name for an advance copy?

The Marley Company

Kansas City, Missouri

MARLEY

LARGE CASING THREADS TAPPED IN 12 MINUTES



BAKER OIL TOOLS, INC., of Los Angeles, California, reports that a **LANDIS** CBLM Circular Chaser Tap mounted on a Stamet's vertical tapping machine has reduced threading time 75% tapping 6⅝" to 13⅜" diameter threads in casing shoes.

Production examples illustrate the large savings made in threading time: (1) tapping 13⅜" N-80 tubular stock, oil well casing shoe with 8 Pitch API round threads 5" long requires but 12 minutes; (2) tapping a 6⅝" piece with an 8 pitch API round thread 5" long takes only 8 minutes. Formerly threading a typical casing shoe would have required all of 40 minutes.

The **LANDIS** CBLM Tap, as used at Baker, is designed for use on production tapping machines to thread line pipe, casing, and drill pipe couplings. The tap head is detachable, and with the use of the various size tap heads available, the CBLM Tap will tap threads ranging from 4½" to 13⅜" O.D. It will cut either 3/16", ⅜", or ¾" tapered threads well within all API Standards, and can also be arranged for straight threading. Infinite taper adjustments are possible either above or below the required degree of taper to assure precision accuracy.

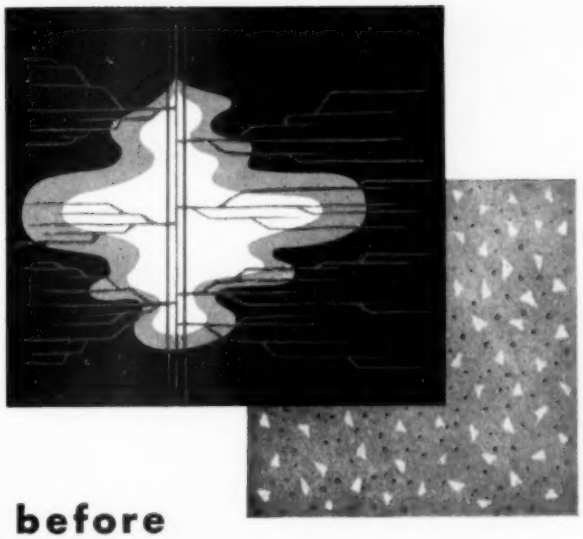
LANDIS manufactures a wide variety of taps for the economical production of internal threads ranging from 1¼" to 13⅜", either straight or tapered threads, on both stationary and rotating spindle machines. To ensure complete information, please enclose specifications when writing.

LANDIS *Machine* CO. WAYNESBORO, PENNSYLVANIA, U. S. A.

Represented in the Domestic Oil Fields by: Colcord-Wright Machinery & Supply Co., St. Louis, Mo.; C. J. Harter Machinery, Houston, Texas; Frederic-Baker Co., New Orleans, La.; Moore Machinery Co., Los Angeles and San Francisco, Calif.; Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.

378-3

HALLIBURTON'S MCA



beneficial before SQUEEZE CEMENTING!

Applying Mud Cleanout Agent ahead of cement is proving extremely valuable in obtaining successful squeeze jobs under difficult conditions.

For example, when a well near Washington, Oklahoma, producing from 9,000 feet, started to make water, seven squeeze jobs were attempted. About 250 sacks of cement were used on each job. Pressure of 6,000 psi was obtained on each squeeze, but after the cement was drilled out, water continued to flow.

On the eighth squeeze, 500 gallons of MCA were placed ahead of the cement. Pressure dropped initially, and then, after only 80 sacks of cement had been squeezed, climbed to 7,900 psi. After the cement was drilled out, the formation was re-perforated to give a flowing well with no water.

The primary job of MCA – a unique blend of Halliburton's Morflo and hydrochloric acid – is to break water blocks, reduce water-swollen bentonitic particles, and destroy emulsions in the vicinity of the bore. But this newest use reveals MCA also is beneficial in the successful completion of difficult squeeze jobs.

Specify MCA for your next job.. for greater permeability. Let Halliburton's big experience work for you. Phone your nearby representative today. Or contact Halliburton Oil Well Cementing Company, Duncan, Oklahoma.

HALLIBURTON

YEARS AHEAD IN PRODUCTION IMPROVEMENT TECHNIQUES!

AHEAD OF THE TANK CARS

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The Southwest's Pioneer Oil Bank

FIRST NATIONAL BANK IN DALLAS

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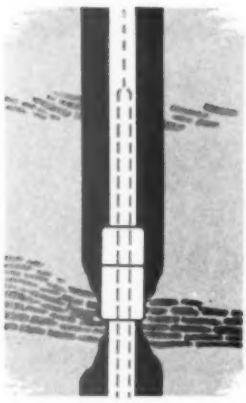
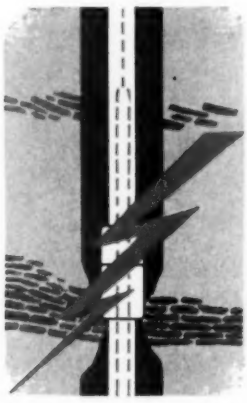
Give us an opportunity to say YES

When you're stuck...

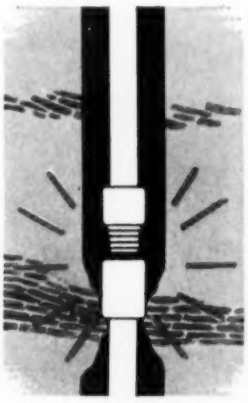
DIA-LOG's *unbeatable combination recovers drill pipe faster than any other method!*



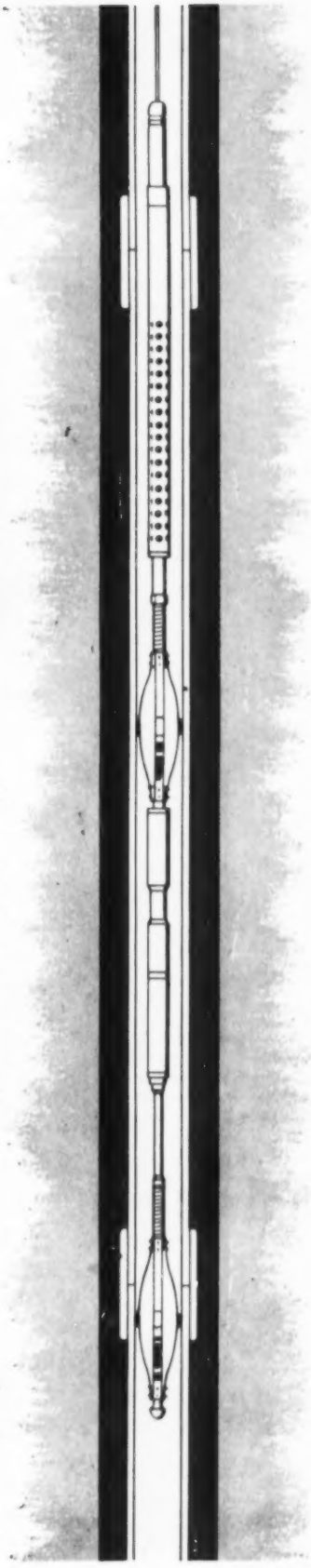
Free Point Indicator locates lowest depth where stretch and torque can be applied on the drill string.



The "String Shot" is lowered to the same depth on the same cable and detonated to loosen tool joint.



Back off recovers stuck drill pipe, drill collars, tubing or casing to permit further fishing operations.



THE DIA-LOG FREE POINT INDICATOR

This tool accurately determines the lowest depth where *both stretch and torque* can be applied to the drill string. It locates the exact point where stuck drill pipe, drill collars, tubing or casing can be freed. Movements as small as *one-thousandth of an inch* are recorded electronically on a surface indicating panel. Since reverse torque is used to back off, pipe to be recovered must be free in torque as well as stretch. *The Dia-Log Free Point Indicator gives you this correct depth in a matter of minutes!*

THE DIA-LOG STRING SHOT BACK-OFF

On the same electric conductor cable used for the Dia-Log Free Point Indicator, a "String Shot Back-Off" is run to the desired depth. Upon detonation, the "String Shot" delivers a sharp jar sufficient to start the unscrewing of the load-free joint. In thousands of successful runs, Dia-Log has recovered *millions* of feet of stuck pipe quickly and economically by employing this infallible combination. The "String Shot" also jars loose stuck tubing packers, frozen overshots, safety joints and stuck liners.

Wherever you are stuck -- Dia-Log Service is available

Dia-Log Service is available in all domestic oil fields. Wire, write or call any Dia-Log Company or Ford Alexander Corporation office for fast, dependable recovery of drill pipe.

OIL WELL ELECTRIC LINE SERVICES

Gulf Coast and Mid-Continent

THE DIA-LOG COMPANY

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Farmington, New Mexico
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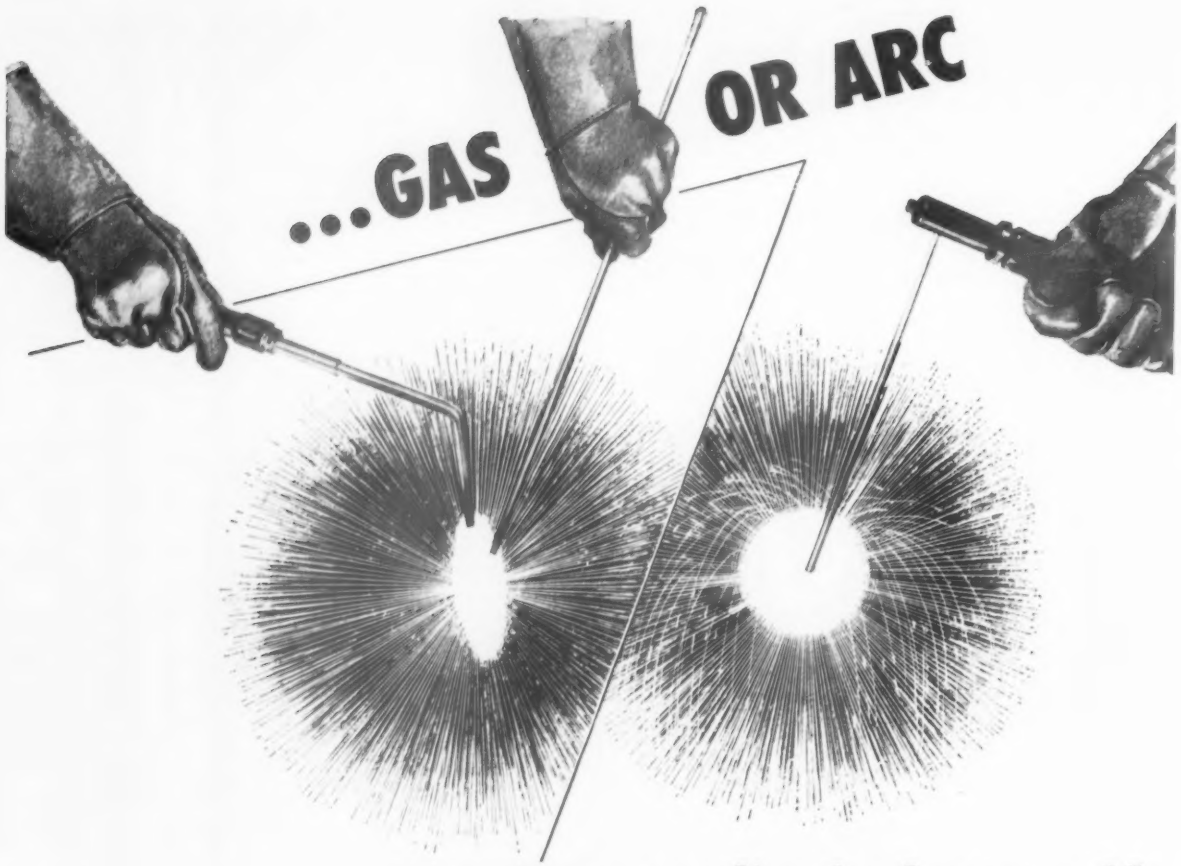
Healdton, Oklahoma
Great Bend, Kansas
New Iberia, Louisiana
Houma, Louisiana
Natchez, Mississippi
El Dorado, Arkansas
Corpus Christi, Texas
Kilgore, Texas

California and Rocky Mountains

THE FORD ALEXANDER CORPORATION

BOX 800 — **WHITTIER, CALIFORNIA**

Ventura, California
Taft, California



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Airco ferrous electrodes: For all types of steel — mild, low-alloy, stainless — and cast iron. Airco electrodes provide arc stability, smooth bead contour, easy slag removal and minimum spatter — that's why Airco is thought of first when welders want ease of operation and high production of quality welds. A complete line of AC and DC types answers all welding problems.

Airco non-ferrous electrodes: Save time and expense welding aluminum, aluminum bronze and manganese bronze, making machinable welds in cast iron, depositing bearing surfaces, build-ups of worn areas and other types of overlays.

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Airco silver brazing alloys and fluxes: Airco offers you the complete line of famous "Easy-Flo" silver brazing alloys. The low flowing temperature of all these alloys saves labor, time and gases, and minimizes distortion. For all types of joints and all combinations of metals.

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Southwestern Headquarters for Oxygen, Acetylene and Other Gases . . . Carbide . . . Gas Welding and Cutting Machines, Apparatus and Supplies . . . Arc Welders, Electrodes and Accessories

WE'LL PUT OUR SHOULDER TO YOUR WHEEL ...Anywhere!

Our Bartlesville store illustrates a J&L conception of dependability. At the same stand it has served some of the same customers for more than 48 years — since the first wells were drilled in Indian Territory.

New stores at Glendive in Montana and Swift Current in Saskatchewan are current illustrations of the J&L conception of availability.

To J&L, customers are important. By using J&L facilities you mold J&L policies to your permanent advantage, as some of those early customers of the old Bartlesville store could well testify.

Call the J&L number in your 'phone book. Let us fill an order or answer a question or help you in any way you wish. Enjoy a sample of what it means to have the J&L shoulder at your wheel whenever and wherever you need it

ANOTHER POWERFUL SHOULDER AT YOUR WHEEL AND OURS, PUSHING ALWAYS IN THE DIRECTION OF PROGRESS: the AMERICAN PETROLEUM INSTITUTE.

J&L STEEL

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EXPORT: 405 Lexington Ave., New York, N. Y., U. S. A.

PESA

cut costs with SMITHway slow closing set stop valves!

Truck Tank Service – Simple as 1-2-3 to make More Deliveries per Day. (1) The tank truck driver can pre-set the exact amount of oil to be delivered, (2) leave the truck and attend to the delivery himself at a distance of many yards. The delivery is measured and controlled directly on the truck meter and (3) the ticket printer provides a printed record of the transaction for both the customer and home office.

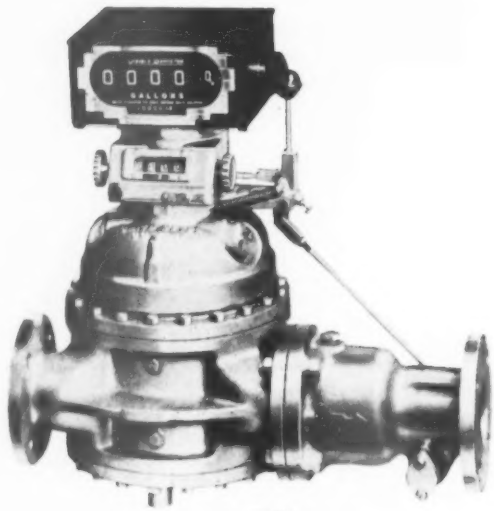
You can cut costs with SMITHway *Slow-Closing* Set Stop Valves and Counters, get *more service* from existing equipment and lighten the work, *increase the efficiency* of your personnel by using these *work-saving functional* accessories. A. O. Smith offers the industry's most complete line with models to suit every rate of flow. *This equipment can be added readily to existing Smith Meters.* See nearest representative or write for complete information. A. O. Smith Corporation, Meter Division, 5715 SMITHway St., Los Angeles 22, California.

79th YEAR 1874 1953

A.O.Smith

METER DIVISION

FACTORIES: 5715 SMITHWAY STREET, LOS ANGELES 22, CALIF. P. O. BOX 500, SUCCASUNNA, N. J.
Offices: Atlanta, Chicago 7, Houston 20, Los Angeles 22, New York 17
Canada: Toronto 12, Vancouver 1. International Div. — Milwaukee 1, Wis.



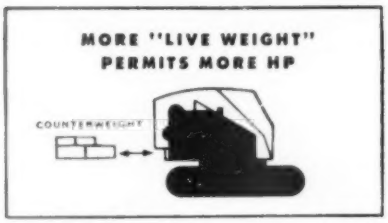
Bulk Plants and Terminals – SMITHway Set Stop Valves make it possible to load two or more compartments or two or more trucks simultaneously. Shut off varied from instantaneous stoppage for low flow rates to slow closing for high flow rates. Various slow closing cycles of 10 to 30 units, depending on requirements. SMITHway Slow-Closing valves also permit exact blending right at the loading rack when necessary.

Before you buy:

COMPARE NET HP!

This LS-85, despite tough, big-chunk rock, has been operating over 1200 hours without requiring one replacement part!

Don't judge available power by engine model only ... NET hp is what adds up to extra profit!



COMPARE shovel-cranes with and without counterweight. That test spotlights the size, weight and heft built into the working parts and structural members. You'll find the LS-85 has more "live weight" than comparable ¾-yard shovel-cranes.

Greater net horsepower assures faster, deeper digging. Bigger loads are handled without stalling. For example: the diesel driven heavy-duty ¾-yard LS-85 packs 92 net hp. That's more power than comparably-sized competitive rigs can safely use. It's why the LS-85 has more digging force behind its bucket teeth . . . why it cuts so smoothly . . . hoists and swings without a pause.

Use of greater net hp is practical because of all-welded, stress-relieved construction *and extra "live weight."* This *extra live weight* is in heavier, sturdier working parts and structural members—rather than a heavier counterweight. All this means year-after-year service and low maintenance costs. So whatever you do, don't compare power by the engine model only—CHECK *NET* HP.

For more facts on the LS-85, ask your distributor, or write for Catalog 2317. For the complete line, request Catalog 2373.

LINK-BELT SPEEDER CORPORATION
Cedar Rapids, Iowa

LINK-BELT SPEEDER CORPORATION

BUILDERS OF A COMPLETE LINE OF CRAWLER, TRUCK AND WHEEL-MOUNTED SHOVEL-CRANES

FACTORY-TRAINED DISTRIBUTOR SALES AND SERVICE SPECIALISTS ...*EVERYWHERE*

NEED NEW OIL FIELD EQUIPMENT?

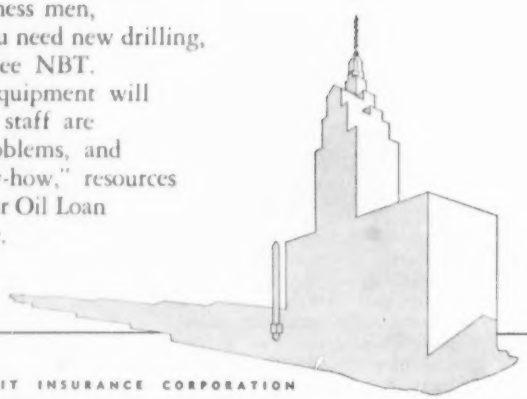
See

NATIONAL BANK OF TULSA

NBT

NBT CAN HELP YOU

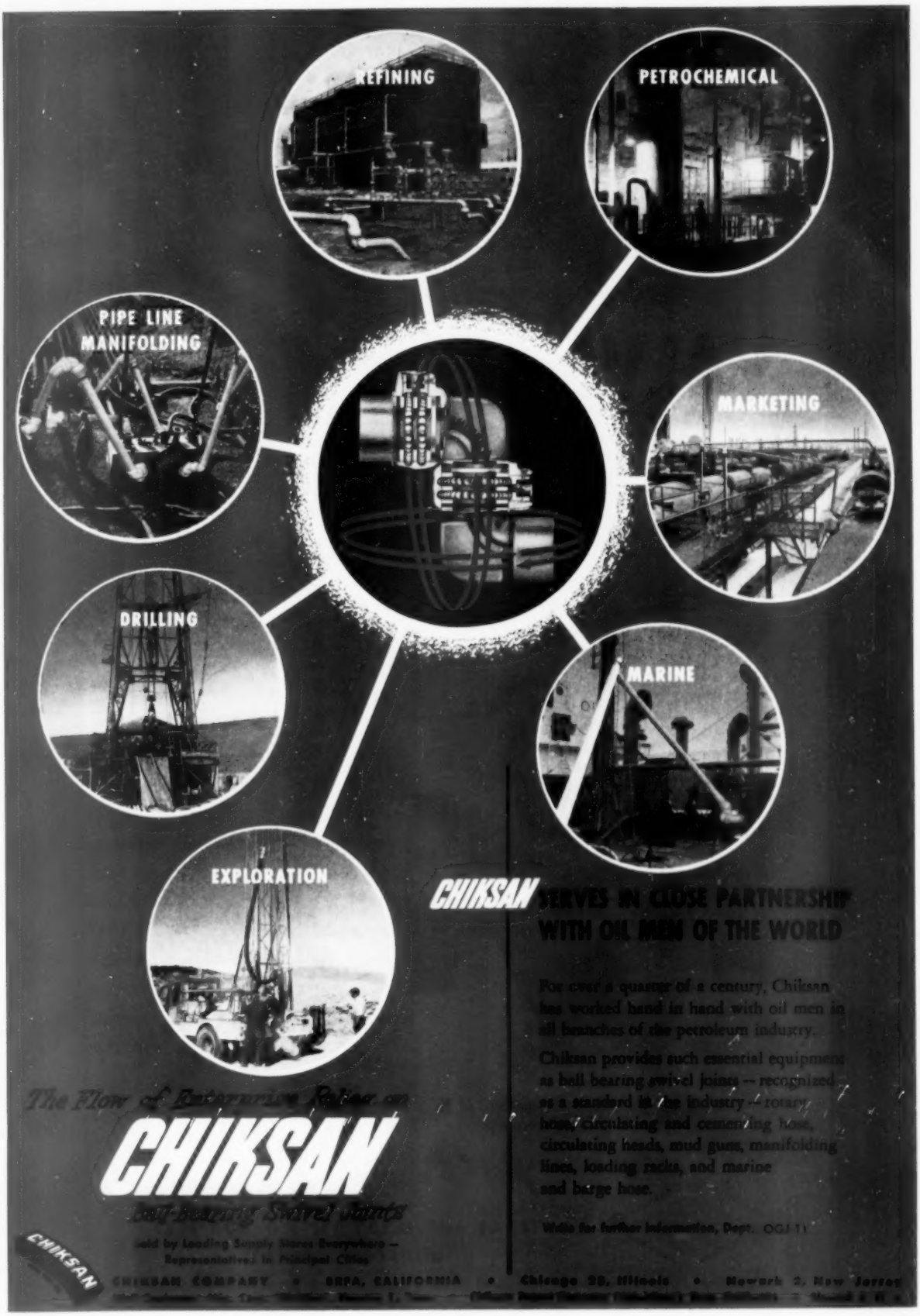
Oil operators and contractors, like other business men, often need new equipment. If you need new drilling, production or transportation facilities, see NBT. Why wait for the benefits new equipment will provide? Oil loan specialists on the NBT staff are familiar with the oil men's problems, and National Bank of Tulsa has the "know-how," resources and desire to assist you . . . so contact our Oil Loan Department whenever you need assistance.



MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

NATIONAL BANK OF TULSA

The Oil Bank of America


REFINING
PETROCHEMICAL
PIPE LINE MANIFOLDING
MARKETING
DRILLING
MARINE
EXPLORATION
CHIKSAN SERVES IN CLOSE PARTNERSHIP WITH OIL MEN OF THE WORLD
For over a quarter of a century, Chiksan has worked hand in hand with oil men in all branches of the petroleum industry.
Chiksan provides such essential equipment as ball bearing swivel joints -- recognized as a standard in the industry -- rotary hose, circulating and cementing hose, circulating heads, mud guns, manifolding lines, loading racks, and marine and barge hose.
Write for further information, Dept. OGJ-11
The Flow of Enterprise Rules on
CHIKSAN
Ball-Bearing Swivel Joints
Sold by Leading Supply Stores Everywhere -- Representatives in Principal Cities
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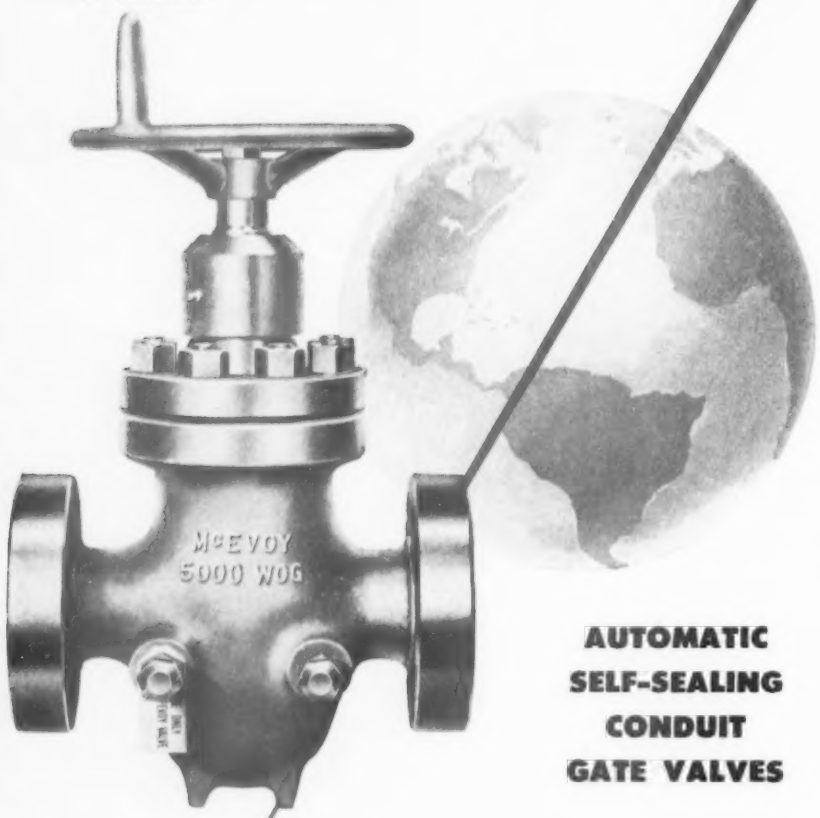
THE WORLD'S

TIGHTEST

VALVES THE McEvoy

(API AND ASA)



AUTOMATIC
SELF-SEALING
CONDUIT
GATE VALVES

STOP LEAKS AS THEY START

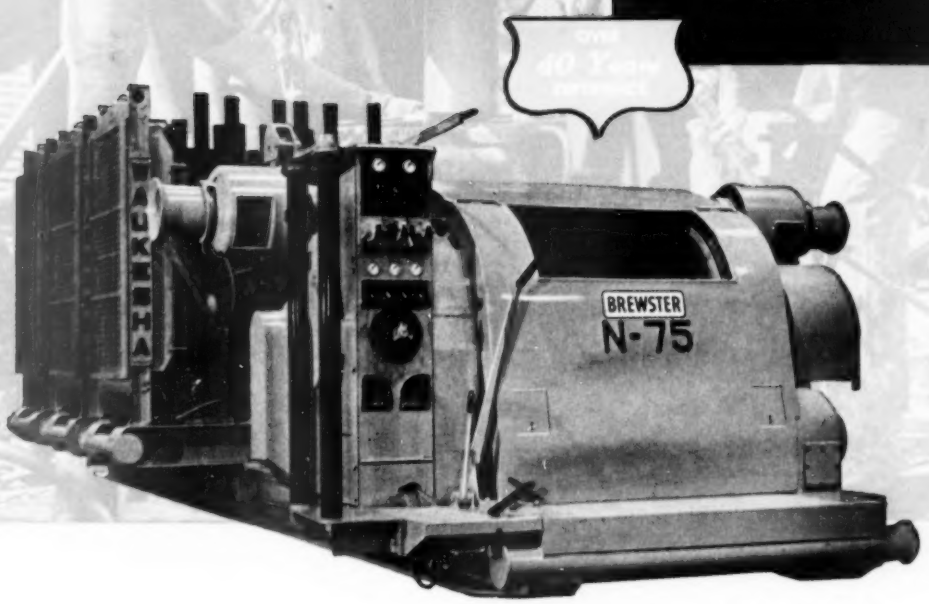
DEPENDABILITY · TIGHTNESS · SAFETY · CONTROL · ECONOMY

McEvoy COMPANY

TEXAS AND MILBY ST. P.O. BOX 3127
HOUSTON 1, TEXAS

Sold Through Leading Supply Stores Everywhere

BREWSTER N-75 DRAWWORKS FOR 10,000' DRILLING



THE N-75 IS A COMPACTLY DESIGNED RIG

Drawworks and compound are mounted on H-Beam skid base with provisions for mounting 2 or 3 engines.

40 years accumulated experience of Brewster engineers and field technicians have been built into the Brewster N-75 drawworks. This rig, newest development of Brewster's oldest drawworks, incorporates the sound principles of other Brewster equipment. More power has been built into the N-75, with the latest improvements in drum and clutch design for faster, deeper drilling.

Ask your nearest Brewster supply house about the newest Brewster drawworks, the N-75.

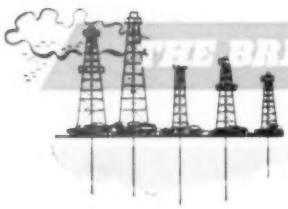
THE N-75 FEATURES

Larger and longer drum core

Extra large chains on high and low drum drives

Increase in power from 600 to 700 horsepower

Auxiliary positive clutch built into low drum friction clutch

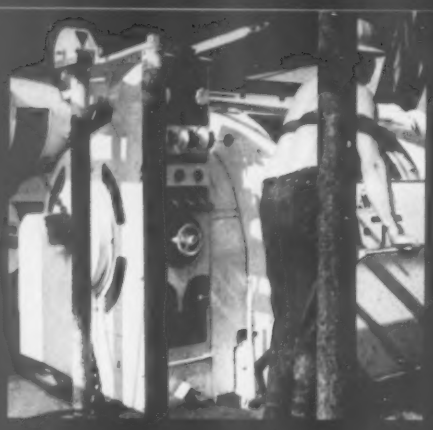


THE BREWSTER COMPANY, INC. SHREVEPORT, LOUISIANA

BREWSTER DRILLING EQUIPMENT

Apex Equipment Co. • Murray Brooks, Inc. • Reams Supply Co. • Bovaird Supply Co. • Industrial Supply Co. • In Canada: Rocky Mountain Supply Co. — Direct and through recognized export dealers.

Chains* in the Brewster compound are well lubricated and operate on accurately cut sprockets.

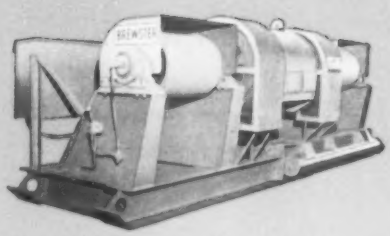


Flexible power of the N-75 is air controlled from driller's position.

Over-all height of 62" affords maximum visibility of rig's operation.

**Chains for compound are selected for the service required to insure a longer chain life with a minimum fatigue failure.*

Brewster double pump drive unit optional on 2 or 3 engine compound.



SPECIFICATIONS FOR BREWSTER N-75 DRAWWORKS

Recommended Total Available Horsepower	700
Max. Dia. Drum Shaft SAE 4140 Alloy Steel	6¼"
Drum Flange Diameter	48"
Drum Spool Diameter x Length	21" x 40½"
Brake Lining Size	1" x 9"
Net Braking Surface (Lining) Square Inches	2376
High Speed Drum Clutch	Twin Disc Friction
Low Speed Drum Clutch — Positive Jaw and Twin Disc Friction Drum Drive Chains	1¾" Triple

Transmission:

Max. Shaft Size	6⅜"
Shaft Dia. in Bearings	4¾"
Chain Size	1¾" Double
Master Clutch	Twin Disc P-2-24 Friction
Reverse	2-Speed Gear
Rotary Clutch Size	Twin Disc P-2-18 Friction

Size Main Skid Members	14 x 14 H
Approx. Over-all Height	80"
Approx. Width of Skids	7'-0"
Approx. Weight of 2-Engine Drawworks, less Engines	45,500 lbs.
Approx. Weight of 3-Engine Drawworks, less Engines	50,000 lbs.

Transmission Speeds	Cathead Shaft RPM	Rotary Drive Sprocket RPM 27T-2" P	Low Speed Drum Drive Line Speeds and Pulls	High Speed Drum Drive Line Speeds and Pulls
Low	101	203	270'/Min 72,000 Lbs.	970'/Min. 20,000 Lbs.
Second	148	297	395'/Min. 52,000 Lbs.	1,415'/Min. 15,000 Lbs.
Third	223	429	572'/Min. 36,000 Lbs.	2,050'/Min. 10,000 Lbs.
High	312	627	835/Min. 25,000 Lbs.	2,990'/Min. 7,000 Lbs.

AUXILIARY DRILLING EQUIPMENT

200 TON TRAVELING BLOCK • 6-S OILBATH SWIVEL • RSH 18" ROTARY

THE BREWSTER COMPANY, INC.

SHREVEPORT, LOUISIANA

what price corrosion?

69 wells

Per gallon cost of Nocor "102"	$ 1.50
No. of gallons used	189
Total cost of inhibitive material	$283.50

Average cost of Nocor "102" per well, per month **$4.11**

These 69 wells are located in the field major operators agree is the most corrosive known. With Nocor "102" ordinarily corrosive wells are even more economical to control.

Figure it out!

In case after case, well after well, Nocor "102" is conquering the costs of corrosion.

During the month of September, 1953, one company's full lease of 69 wells received a treatment of 189 gallons of Nocor "102". Total cost of Nocor "102" was $283.50.

September was the *sixth consecutive month* of full-lease treatment with Nocor "102" exclusively — *without a single failure in any well attributable to corrosion.* These wells range in water production from slight traces to extremes.

This one of countless instances on record which prove beyond doubt that wherever corrosion occurs in pumping wells, Nocor "102" saves money.

Try it and see!

For the complete story write today for this free 12-page booklet.

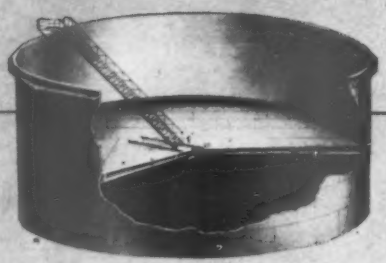
CARDINAL CHEMICAL · INC.

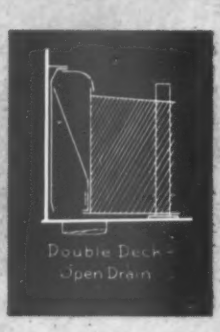
Home Office ODESSA · TEXAS Box 2049

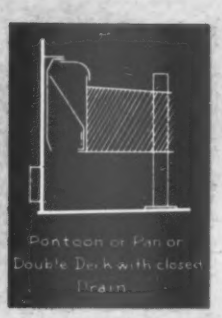
operators of floating roof tanks

You can get...

substantially more capacity from floating roof tanks







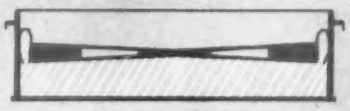
because: they can be made to travel right down to the floor of the tank, thus permitting *all of the tank capacity to be used.*

There are no fittings or supports to take up valuable storage space in Hammond designed and built Floating Roof Tanks . . . their Springtite Seal Floating Roofs can travel from the top of the tank right down to the floor so that all of the tank capacity can be used . . . this design and construction in no way sacrifices any of the values required of a floating roof tank.

Hammond Floating Roofs reduce evaporation and breathing losses, eliminate filling losses, minimize fire hazards and decrease corrosion

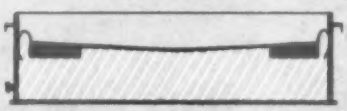
. . . and they permit all of the tank capacity to be used.

HAMMOND FEATURES THREE TYPES OF FLOATING ROOFS



DOUBLE-DECK SPRINGTITE FLOATING ROOF

LOW SPRINGTITE FLOATING ROOF



HIGH SPRINGTITE FLOATING ROOF

. . . for full details write for Bulletin 51 F.

HAMMOND IRON WORKS

WARREN and BRISTOL, PA. • PROVO, UTAH • CASPER, WYO. • BIRMINGHAM, ALA.

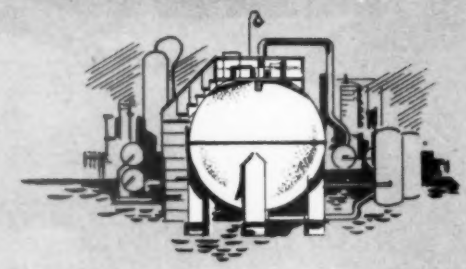
Sales Offices NEW YORK 20 • AKRON • BOSTON 10 • BUFFALO 2 • CHICAGO 3 • CINCINNATI 2 • CLEVELAND 15 • EL PASO • HOUSTON 2 • LOS ANGELES 14 • PITTSBURGH 19 RICHMOND 20 • SAN FRANCISCO • WASHINGTON 6, D.C. • HAVANA • "TIPSA," BUENOS AIRES

ON THE PACIFIC COAST BY LACY MFG. CO. • LOS ANGELES, CAL. • IN CANADA BY VULCAN IRON & ENG. LTD. • WINNIPEG

THESE PETRECO ELECTRIC PROCESSES

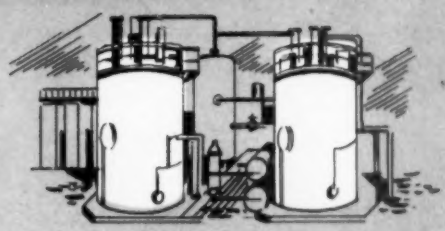
Help refiners to run more crude, treat distillates more efficiently, increase profits substantially.

DESALTING



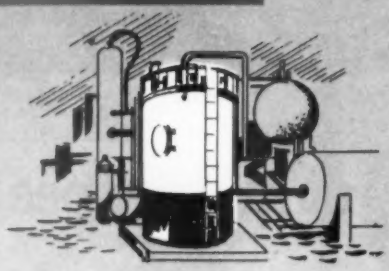
By efficiently removing salts, solids and other impurities, Petreco desalting enables refiners to run more crude. A survey of 62 Petreco customers shows that refinery charge rates were increased on an average of 21.3%; these gains being directly attributed to efficient desalting.

LUBE OIL TREATING



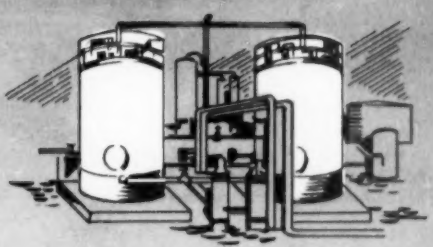
By offering a continuous, automatic lube oil acid-treating process, Petreco provides for substantial savings in acid consumption, ground space and time; it eliminates guesswork and insures against human error. Petreco treating insures minimum oil losses, maximum product quality.

DISTILLATE TREATING



Applicable to acid, alkali or doctor treating, the Petreco process takes guesswork out of distillate treating. It permits continuous, automatically controlled treating with minimum equipment, handling, and attention. Processing is in a closed, non air-polluting system.

DESAPONIFICATION



Petreco treating removes about 85% of the ash-forming constituents in fuel stocks which result from the addition of caustic to crude before distillation. This purification enables the fuel stock to be used as a cracking charge or marketed profitably.

For complete information on any or all of these Petreco profit-promoting processes, call or write to

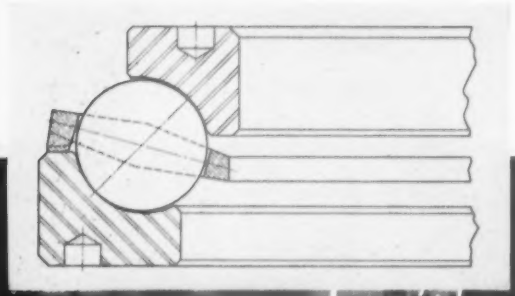
PETROLITE CORPORATION—*Petreco Division*

3202 SO. WAYSIDE DRIVE, HOUSTON 1, TEXAS

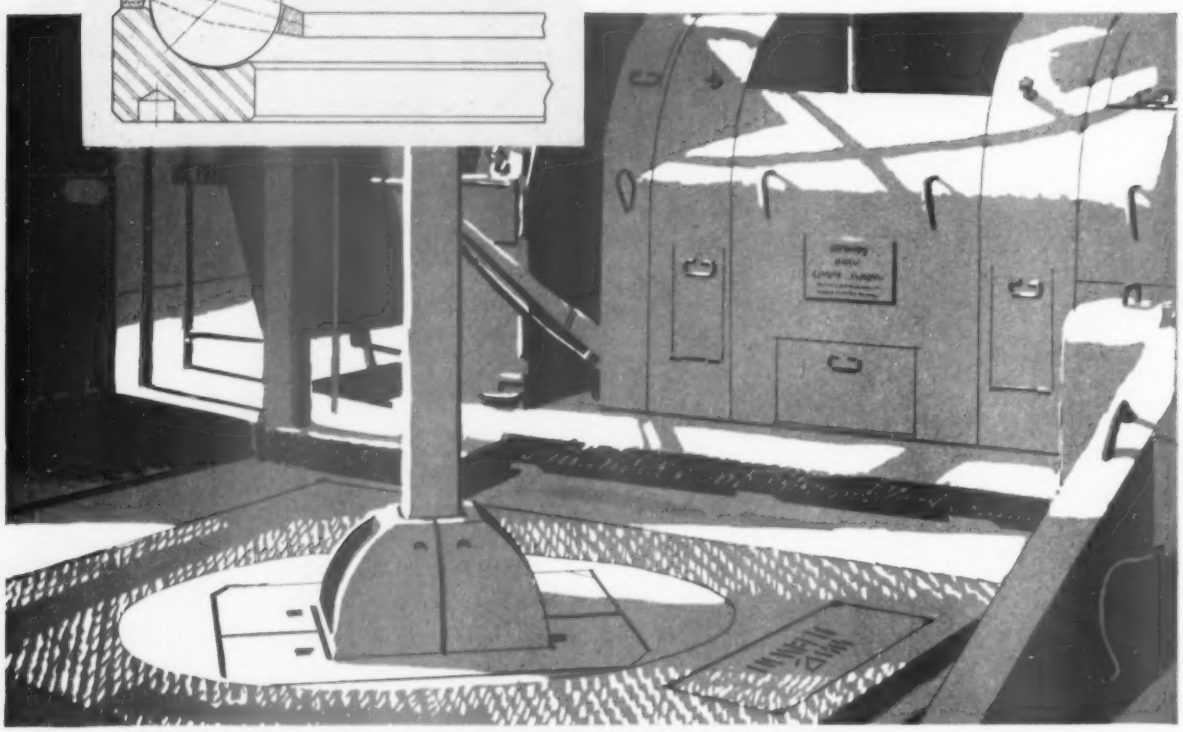
1390 E. BURNETT STREET, LONG BEACH 6, CALIFORNIA

PETRECO

ELECTRIC PETROLEUM PROCESSING



For maximum speed, capacity, long-run economy, Oil Well Supply Division, United States Steel Corporation, uses TORRINGTON Angular Contact Ball Thrust Bearings for all four models of its "oilbath" rotaries.



Reaching for Oil at higher speeds!

TORRINGTON Angular Contact Ball Thrust Bearings give you maximum load capacity and rolling efficiency in rotaries. They are designed to handle highest thrust loads, *plus* radial loads imposed by the driving gear, as well as any off-center loading which may be developed by the rotating drill string. They keep tables centered at all times, cut friction to a minimum, permit deeper drilling at higher speeds.

Equally important, TORRINGTON Angular Contact Ball Bearings are quality built for real long-run economy. Bearing alloy steels—carefully heat treated by the most advanced methods—assure excellent resistance to shock and wear. Machined, cast-bronze cages increase bearing life, hold down operating costs.

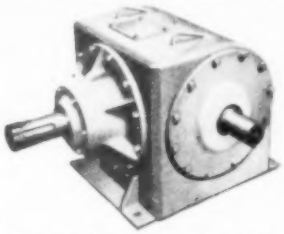
Keep these facts in mind next time you specify rotary table bearings. Then specify TORRINGTON Angular Contact Ball Bearings—and see for yourself why it pays!

THE TORRINGTON COMPANY

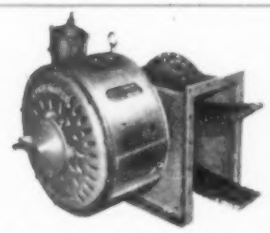
South Bend 21, Ind. • Torrington, Conn.

TORRINGTON BEARINGS

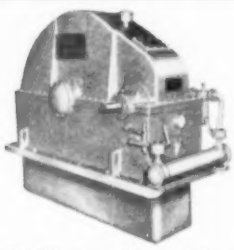
Spherical Roller • Tapered Roller • Cylindrical Roller • Needle • Ball • Needle Rollers



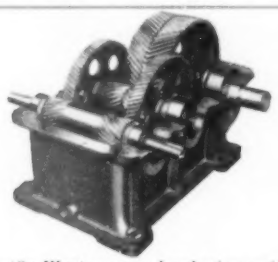
This right-angle gear box is designed for transmitting power to operate a rotary table.



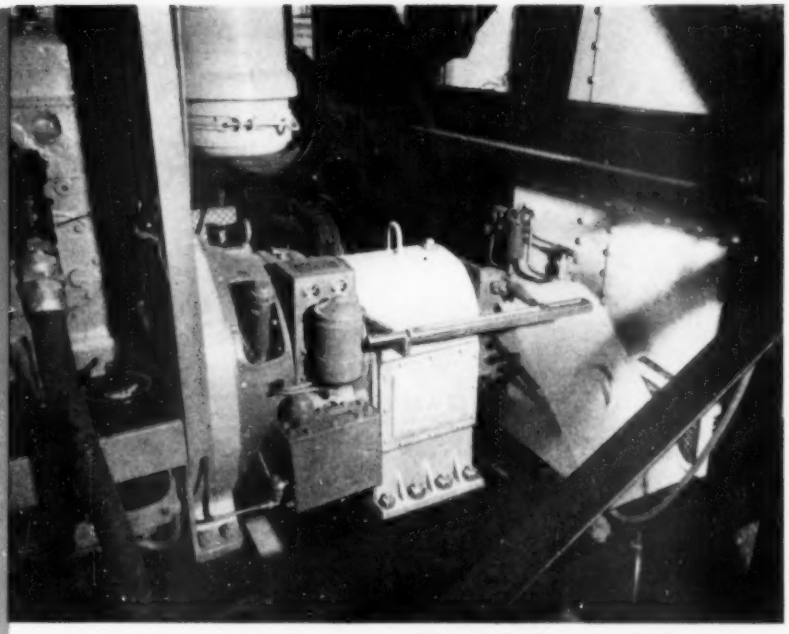
The Torq-Master unit is designed for application to Torque-Converters and can be adapted to Pacific-Western Converters and other leading makes.



Pacific-Western high speed units for stepping-up speed from prime mover to pump.



Pacific-Western speed reducing units for stepping-down speed from prime mover to pump. (Case cover removed.)



TSO unit two speed transmission. Photograph shows installation on diesel engine used to drive rotary table drive.

FOR BETTER GEAR DRIVES...

see WESTERN GEAR!

We offer a complete line of gear drives, especially designed for the many and varied requirements of the Petroleum Industry. *Plus* engineering assistance in development of the installation!

Our 65th year

WESTERN GEAR WORKS

Manufacturers of **PACIFIC-WESTERN** Gear Products

Pacific Gear & Tool Works

Plants: Seattle, San Francisco, Belmont (S. F. Peninsula), Lynwood (Los Angeles County), Pasadena, Houston

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500 South Ervay Street, Dallas, Texas
Engineering & Machinery Ltd., 1366 W. Broadway, Vancouver, B. C.

WESTERN GEAR WORKS
Executive Offices, Post Office Box 182, Lynwood, California

Please send booklets checked:

- ☐ Manufacturing Information, No. 5200
- ☐ Gear Drives for Pipeline Service No. 5204
- ☐ Herringbone Speed Reducers, No. 4802
- ☐ Right Angle Speed Reducers, No. 5203

NAME _____

COMPANY _____

TITLE _____

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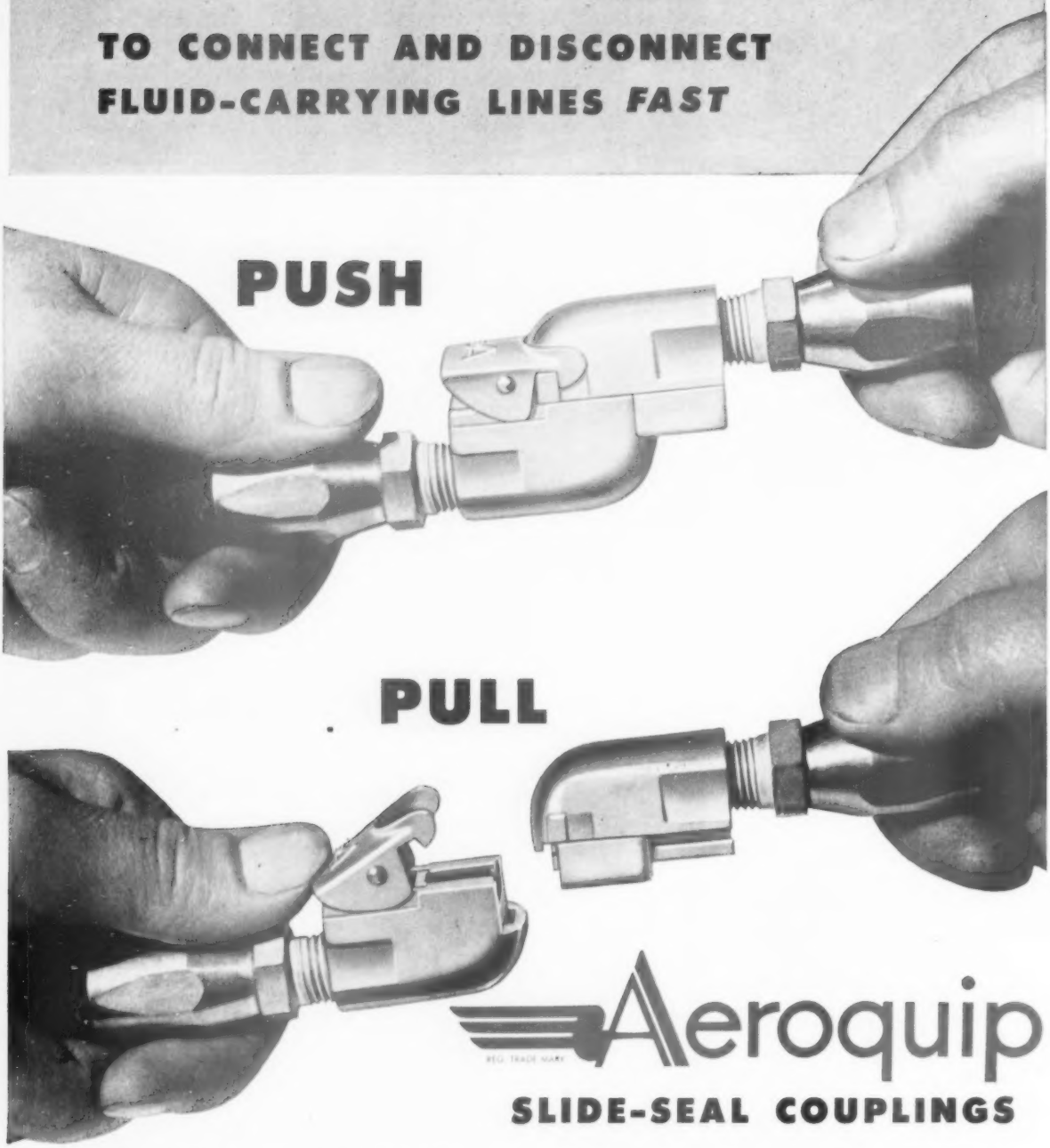
CITY _____ ZONE ____ STATE _____

TO CONNECT AND DISCONNECT FLUID-CARRYING LINES *FAST*



Aeroquip

REG. TRADE MARK

SLIDE-SEAL COUPLINGS

This Aeroquip development saves you time and money!

LOW COST . . . Aeroquip Slide-Seal Couplings connect and disconnect fluid-carrying lines instantly assuring full flow of fluids when connected, and perfect seal of each half when disconnected.

LIGHTWEIGHT AND COMPACT . . . They are ideal for use in confined areas and may be used to advantage in a wide variety of applications.

SIMPLE DESIGN . . . Only four working parts and two "O" rings assure positive performance and foolproof operation.

ADAPTABLE for use with many fluids including hydraulic fluids, hot oil, crude and fuel oils, anti-freeze solutions, gasoline, Diesel fuels, air, water, and other fluids.

Descriptive literature is available . . . please write.

AEROQUIP CORPORATION, JACKSON, MICHIGAN

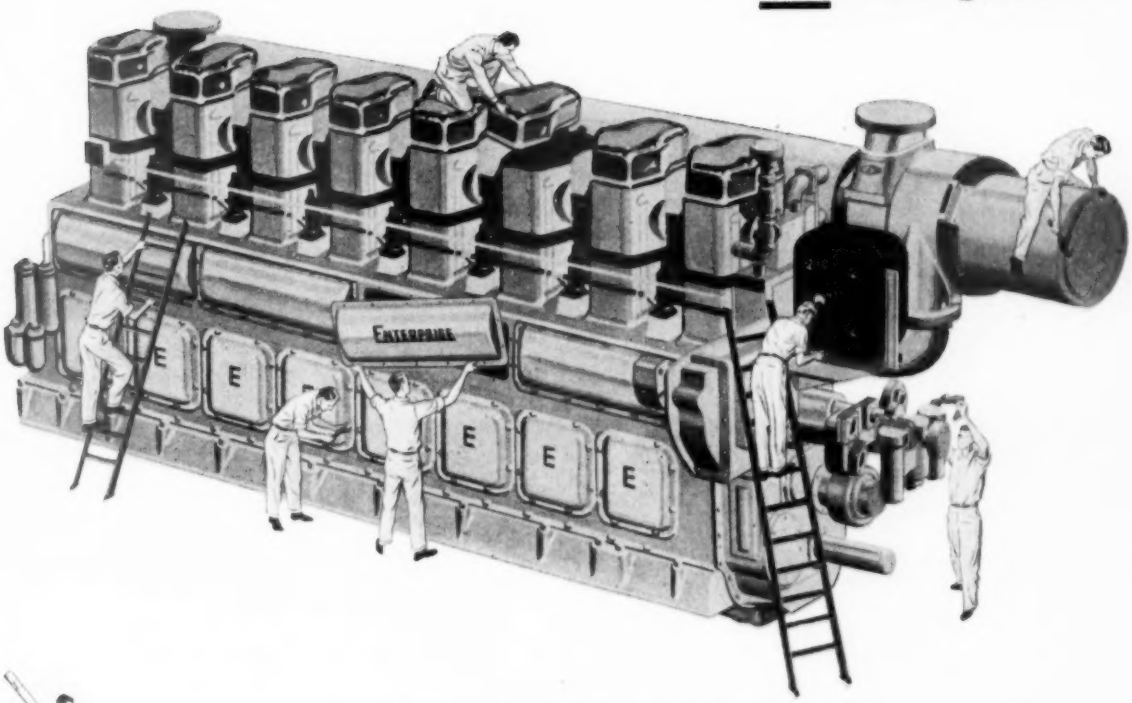
SALES OFFICES: Burbank, Calif. • Dayton, Ohio • Hagerstown, Md. • High Point, N. C. • Miami Springs, Fla. • Minneapolis, Minn. • Portland, Ore. • Wichita, Kan.

IN CANADA: Prenco Progress and Engineering Corporation Ltd., Toronto

IN ENGLAND: Super Oil Seals & Gaskets, Ltd., Birmingham

AEROQUIP PRODUCTS ARE FULLY PROTECTED BY PATENTS IN U.S.A. AND ABROAD

It's easy to get to all the parts



Check these points
on "Easy-Access" ENTERPRISE Design
All major moving parts are enclosed with removable covers:
Main and connecting rod bearings are fully accessible through large door plates on both sides.
Cams, followers, camshafts and bearings are easily reached and removed.
Cylinder head and rocker arm assemblies, push rods and fuel nozzles are easy to reach by removing oil and dust-proof covers.
Gears are accessible through easily removable inspection covers.
No bulky shrouds or surplus covers to remove before getting to engine.
Parts, accessories and controls requiring occasional inspection or servicing are externally mounted.

You'll find that ENTERPRISE accessibility saves time, money and manpower in maintenance and overhaul

Ever watch precious hours slip by trying to find a way to dismantle, inspect or replace an engine part or assembly? Such unnecessary and costly down-time is something you don't have to worry about with modern, "easy-access" ENTERPRISE Diesels. For ENTERPRISE service-wise engineers have designed every model in the entire 73 to 2284 HP line for maximum accessibility and easy, low-cost servicing. That's why we say – and mean – you'll have less down-time if it's powered by an ENTERPRISE Dependable Diesel!

Write for descriptive bulletins, or call your nearest ENTERPRISE *Diesel sales office.*

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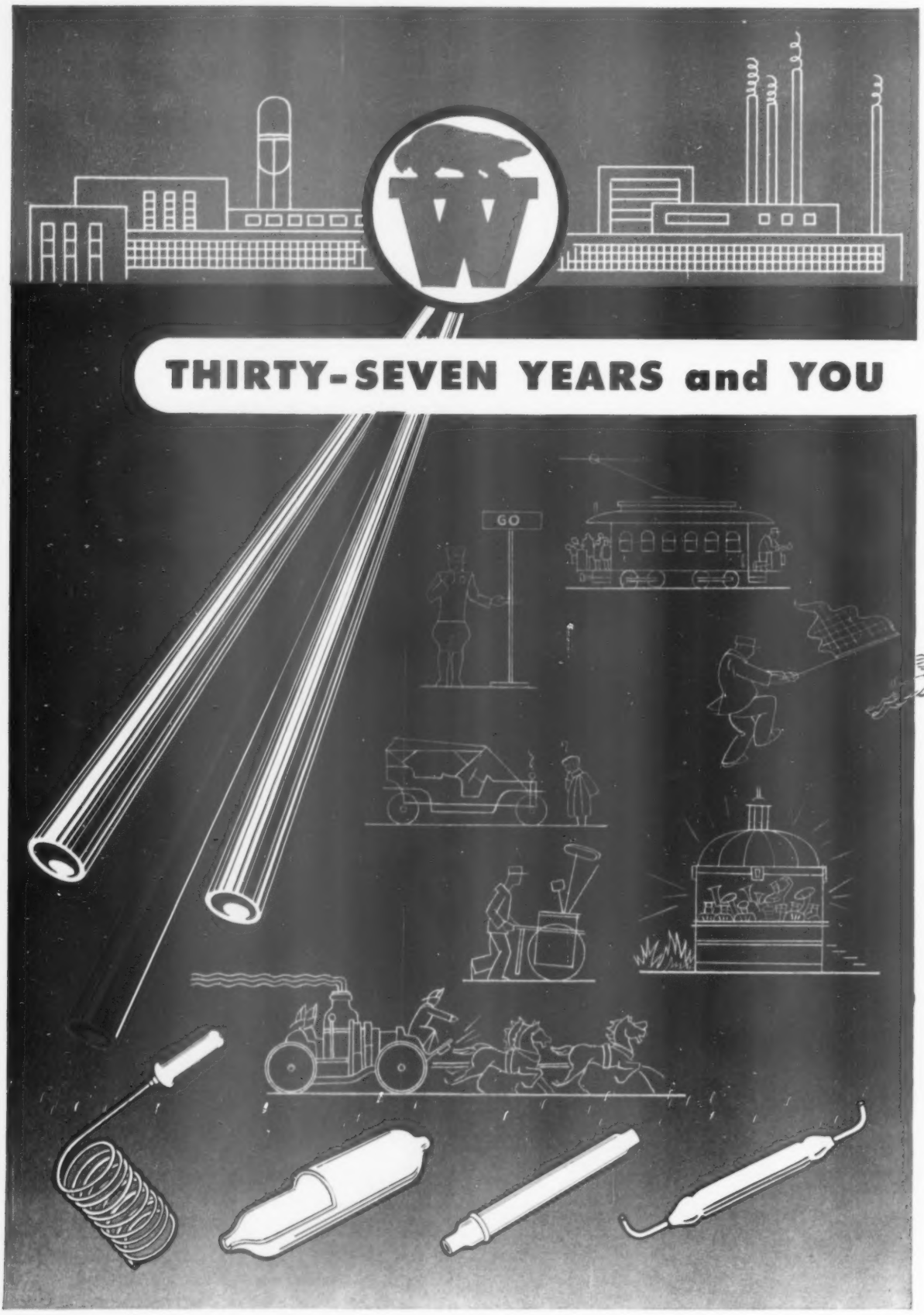
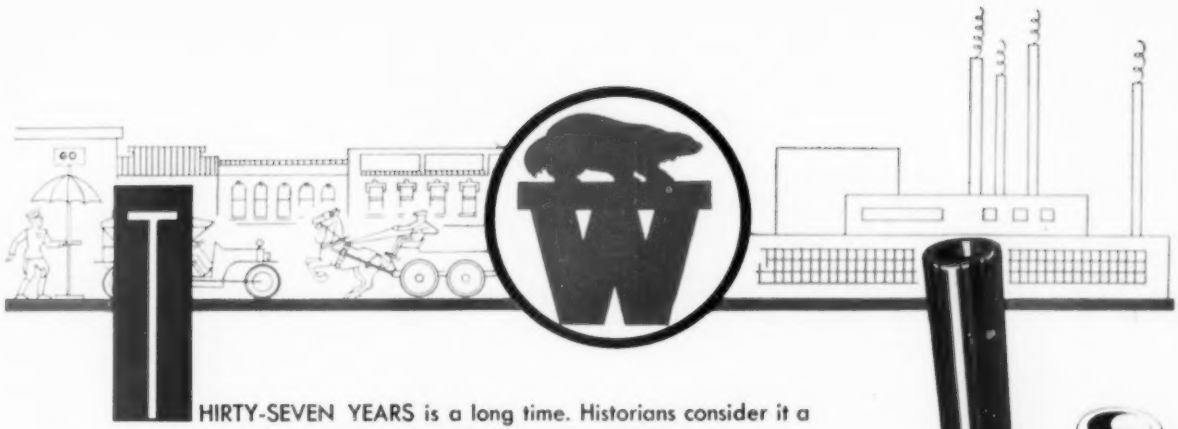

THIRTY-SEVEN YEARS and YOU
GO



THIRTY-SEVEN YEARS is a long time. Historians consider it a generation. Many things happen in that length of time to change our lives. The passing years add experience that guides our forward steps.

Since the start of our business, thirty-seven years ago, many changes have taken place here at Wolverine. Each has been a step forward—the natural result of experience that has been constantly furnishing the inspiration for us to keep looking ahead in search of better ways of doing things, in order that we may bring you the best tube products that human effort, skill, and modern equipment can provide.

Our efforts are not alone confined to the manufacture of tubing, but are also devoted to finding ways and means that will make your tube installations most efficient and profitable.

As tube specialists we interest ourselves in both the production of condenser tubing and its proper use in the field—counseling with the users as to the best alloy to use under their prevailing corrosion conditions. This applies to the use of copper, copper-base alloy, electric-welded steel and aluminum (2S and 3S) condenser tubing.

In addition to prime surface condenser tube, Wolverine has also developed a unique finned tube for use in condensers—called Wolverine Trufin*—the integral finned tube. The specialized design of Trufin enables extended surface tube to be an economic standout in shell and tube heat exchanger installations.

Get the complete factual picture—ask for our condenser tube catalog.

Wolverine Trufin and the Wolverine Spun End Process available in Canada through the Unifin Tube Co., London, Ontario.

*REG. U. S. PAT. OFF.

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Manufacturers of Quality-Controlled Tubing

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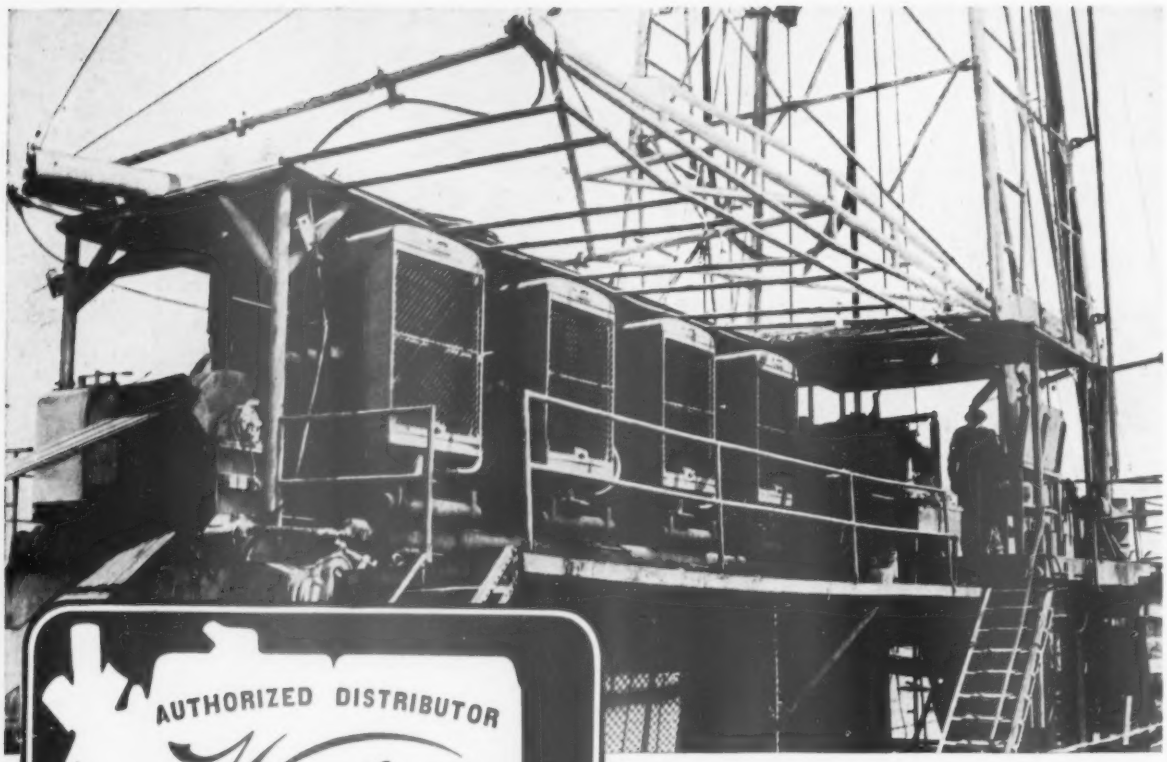

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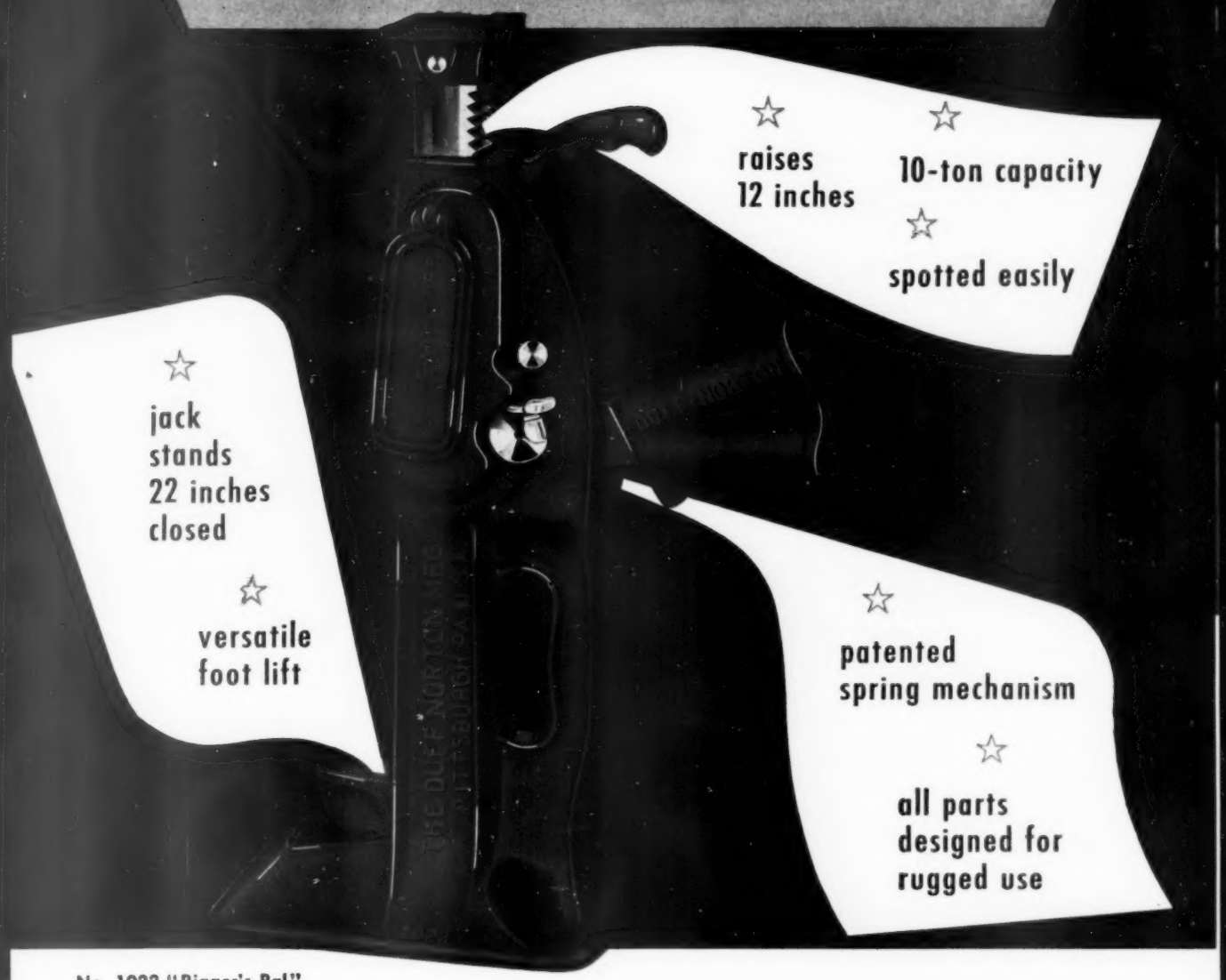
201-R

Read why the light-weight 1022 Jack is called the "Rigger's Pal" by oil men



No. 1022 "Rigger's Pal"

For erecting drilling rigs and lifting and lowering heavy equipment of all kinds, the Duff-Norton 1022 "Rigger's Pal" Ratchet Lowering Jack is your best bet. Here's why oil men call it the "Rigger's Pal":

- Spotted easily, it can be operated by one man.
- It uses its foot as well as its head. Versatile foot lift starts raise 2¼ inches above base.
- Like all Duff-Norton jacks, the 1022 has the patented, adjustable, spring mechanism assuring absolutely safe, trouble-free service. The spring's tension is easily adjusted with a screwdriver without removing any part of the jack.
- Without straining any part of the jack, it moves 10 tons.
- When closed it is only 22 inches high, yet has a raise of 12 inches.
- It is specially designed for rugged outdoor use.

Get the complete story on the 1022 and other famous Duff-Norton Jacks for oil men. Inquire at your oil field supply store or write the world's oldest and largest manufacturer of lifting jacks. Ask for Oil Field Jack Bulletin AD 19-B, The Duff-Norton Manufacturing Co., P.O. Box 1889, Pittsburgh 30, Pa. Canadian plant —Toronto 6, Ontario.

DUFF-NORTON *Jacks*

"Giving Industry A Lift Since 1883"

Graphic control . . . *for leading industries*

The well-established trend to centralized graphic instrumentation has brought with it many specific advantages to the operation of complex, modern processing units. And to realize most fully the potential advantages of improved efficiency, simpler supervision and better coordination, many leading companies have turned to Honeywell graphic control.

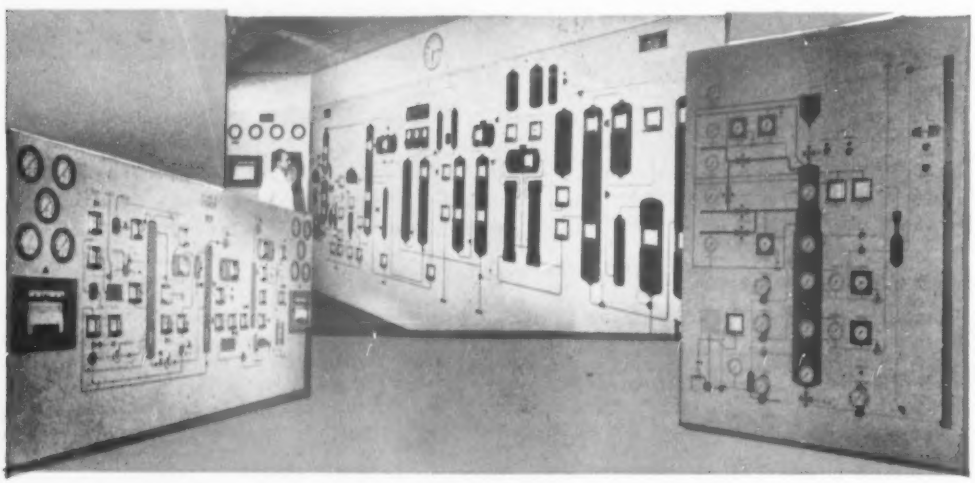
Among the engineering, construction and producing organizations which use Honeywell panels are some of the best-known names in their fields. The ever growing list includes:

C. F. Braun
Catalytic Construction Co.
The Fluor Corporation Ltd
Foster Wheeler Corp.
Gulf Oil Corporation
Imperial Oil of Canada
M. W. Kellogg
The Lummus Co.
Pan-Am, Southern
Phillips Petroleum Co.
The Refinery Engineering Co.
Shell Oil Co.
Sinclair Refining Co.
Socony-Vacuum Oil Co.
Standard Oil Co. of California
Standard Oil Co. of Indiana
Standard Oil Co. of New Jersey
The Texas Company
Tide Water Associated Oil Company
Union Oil Co. of California

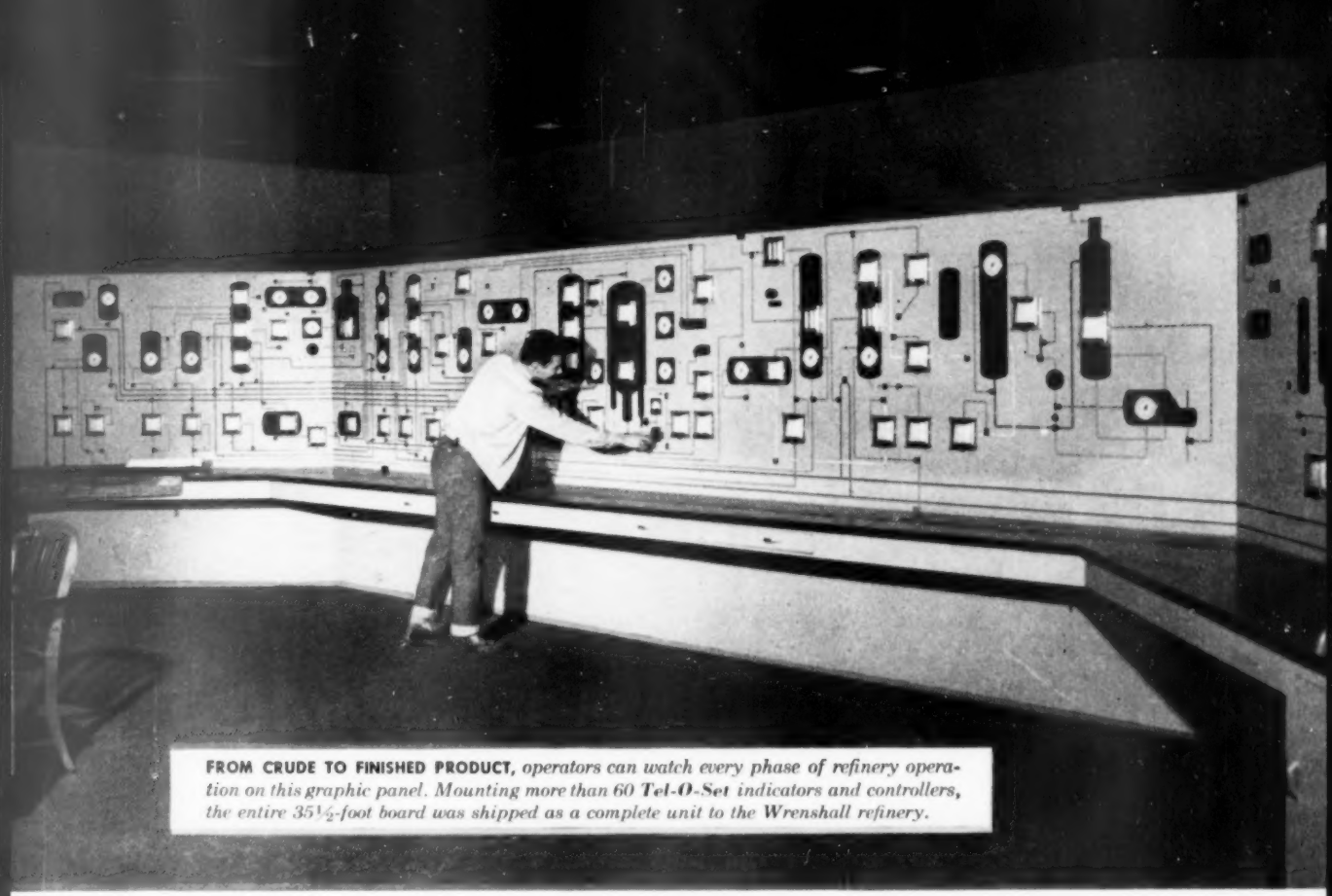
Reasons for acceptance

Behind this industry-wide acceptance stand several definite reasons. First is system engineering . . . by graphic panel specialists who translate process requirements into an integrated, harmonious design. Second is instrumentation . . . including a full line of *Tel-O-Set* miniature indicators, recorders and controllers, and *ElectroniK* instruments for supplementary recording, which enable Honeywell to satisfy the requirements of every phase of process control. And third is workmanship . . . skilled assembly either in a manufacturing department devoted exclusively to this work, or, if desired, at the job site by our own experienced branch installation crews—an organization built up over 15 years for the installation of industrial and commercial control systems.

Graphic control *centralized*



FUNCTIONAL DESIGN *for maximum efficiency is the keynote of Honeywell graphic instrumentation. These typical panels show a few of the varied types which have been built for varied process applications.*



FROM CRUDE TO FINISHED PRODUCT, *operators can watch every phase of refinery operation on this graphic panel. Mounting more than 60* ***Tel-O-Set*** *indicators and controllers, the entire 35½-foot board was shipped as a complete unit to the Wrenshall refinery.*

for complete refinery *on a single Honeywell panel*

THE MOST up-to-date concepts of petroleum processing were embodied in International Refineries' new plant at Wrenshall, Minnesota. Designed and built by the Lummus Company, this refinery produces straight run, cracked and polymer gasolines, diesel and other fuel oils, all of which are distributed by Western Oil & Fuel Co.

An outstanding feature of this new refinery is its continuous flow operation . . . no intermediate storage tanks are needed between processing stages. This "straight through" design naturally calls for precise, closely integrated control of related processes. To meet these exacting control requirements, refinery and design officials selected Honeywell graphic control.

The big graphic panel shown above combines all the instrumentation for eight different refining processes. Operators can follow the entire functioning of the plant from crude to finished products, from this single control center. Worked out in detail by Honeywell design specialists, this panel does the job that would ordinarily require four or more separate panels. Not only were substantial savings effected in space, but the panel affords complete centralization of plant control . . . flexibility to meet seasonal variations in product demand . . . and maximum efficiency of process supervision, both for operators and for management personnel.

Your nearby Honeywell sales engineer will welcome the opportunity to discuss your graphic control requirements. Call him today . . . he is as near as your phone.

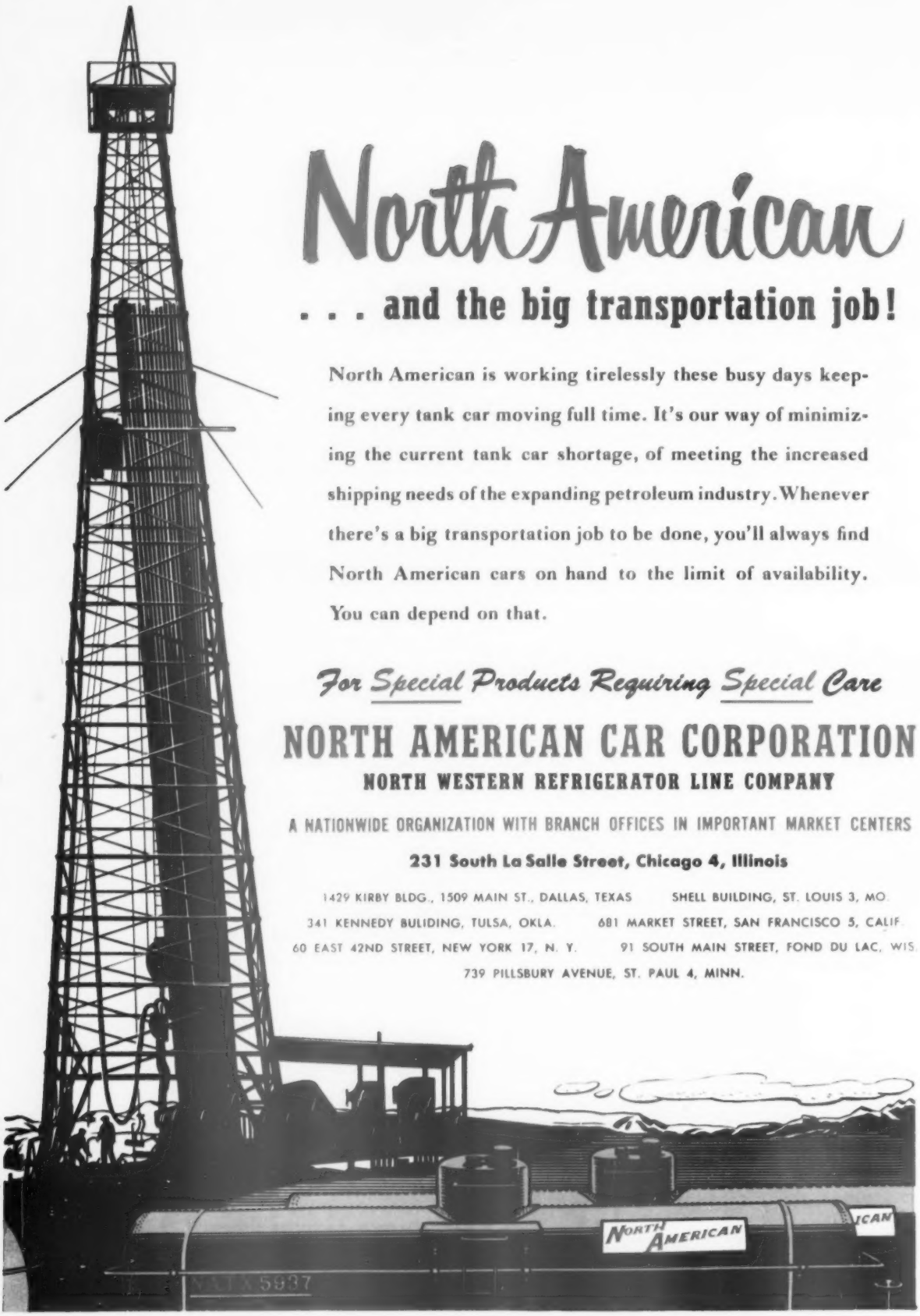
MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4488 Wayne Ave., Philadelphia 44, Penna.

● **REFERENCE DATA:** Write for Bulletin 85-20, "Centralized Instrumentation . . . unlimited."

MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

First in Controls



North American

. . . and the big transportation job!

North American is working tirelessly these busy days keeping every tank car moving full time. It's our way of minimizing the current tank car shortage, of meeting the increased shipping needs of the expanding petroleum industry. Whenever there's a big transportation job to be done, you'll always find North American cars on hand to the limit of availability. You can depend on that.

For Special Products Requiring Special Care

NORTH AMERICAN CAR CORPORATION

NORTH WESTERN REFRIGERATOR LINE COMPANY

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New... and too good to miss!

Now, for the first time, lubricated plug valves that carry the Powell name and measure up to the Powell standards of precision are available in Semi-Steel and Carbon Steel.

You'll want the new PV-2 Catalog in your files. In fact, no valve file can be considered complete without it. And it's so easy to get. Just fill out the coupon below and mail. No charge, no obligation.

As you page through the catalog, you'll see the details that maintain these great new valves in the century-young Powell tradition. Features include quick and positive operation—just a quarter-turn of the Lubricated Tapered Plug to open or close. Lubricant grooves surrounding each port provide a positive seal when the valve is closed. In an open position, seating surfaces are not exposed.

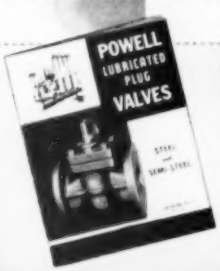
Powell Lubricated Plug Valves are available with Screwed or Bolted Glands. Semi-Steel Valves are available for 175 and 200 pounds W.O.G. Carbon Steel Valves are available for 150 and 300 pounds W.P.

Powell Valves

THE WM. POWELL COMPANY • DEPENDABLE VALVES SINCE 1846 • CINCINNATI 22, OHIO

Free! SEND FOR THE PV-2 CATALOG TODAY

... it's too good to miss!



THE WM. POWELL COMPANY
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Gentlemen:
I want to bring my valve file up to date. Please send me a copy of your PV-2 Catalog on Powell Lubricated Plug Valves.

NAME_____ TITLE_____

COMPANY_____

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• for steady "ON SCHEDULE" production

in all kinds of going

• Pipeliners the world over know from experience that CLEVELANDS deliver trench *on schedule* no matter how tough the digging. CLEVELAND dependability is the result of a *perfectly balanced combination* of practical pipeline trencher features:

BUILT TOUGH. Modern, proved design and tough alloy steels strip off all dead weight, make every CLEVELAND pound a working pound.

LONG LIVED. Quality construction keeps CLEVELANDS "on the line" delivering "on schedule" peak production day in and day out, year after year.

UNIT DESIGN. All major components are "packaged" and easily accessible, permitting speedy, on-the-job repairs and wear parts replacement.

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nothing can match the genuine . . .

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Designing, Developing, Engineering, Manufacturing and Service

Spicer

Man aspires . . . nature transpires. The standards of excellence achieved in nature's masterpieces cannot be duplicated by the hand of man. Yet man . . . each in his own field . . . achieves his own incomparable measure of success. Through pioneering, research and progress in the field of automotive power transmission, Spicer has during the past 50 years established an enviable reputation as the

Leader in the Industry.

nothing can match the genuine . . .

The great preference for Spicer Universal Joints and Propeller Shafts is the result of many exclusive advantages, both in manufacturing experience and design.

Spicer revolutionized automotive power transmission in 1904 with the invention of the first practical universal joint.

Spicer developed the telescoping action so necessary in propeller shaft action.

Spicer developed the flange yoke and companion flange idea.

Spicer developed the outer casing of universal joints for better lubrication and protection.

Spicer introduced spring retainers that automatically compensate for packing wear.

Spicer pioneered the tubular shaft which enabled large diameters to be used with light weight.

Spicer developed the I-G type joint to seal in lubricant.

Spicer perfected cageless roller bearings, giving the Spicer Universal Joint far greater load capacity at higher speeds with less friction than any other type of similar product.

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of Dana Corporation • Toledo 1, Ohio

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The Petroleum Industry

STOPS RUST! with RUST-OLEUM

The Practical Way to Save Pipes, Tanks, Derricks, Buildings, Pumps, Roofs, Fences

Ask the maintenance men who battle rust daily! They'll tell you that RUST-OLEUM is the practical answer. (1) It may be applied directly over surfaces *already rusted* without removing all the rust. Wirebrushing and scraping with sharp scrapers to remove rust scale and loose particles is all that is usually required . . . eliminating costly sandblasting and chemical pre-cleaning . . . often enabling one man to do the work of two. (2) RUST-OLEUM *beautifies as it protects in all colors, aluminum, and white.* (3) RUST-OLEUM *stops rust* on every rustable metal surface indoors and out.

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May be applied directly over rusted surfaces without removing all the rust!
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For 15 Years... Reducing Oil Well Pumping Costs

VICKERS *Long Stroke*
HYDRAULIC PUMPING UNITS

Since the first installation in 1937, Vickers Hydraulic Pumping Units have been cutting the cost of lifting crude oil. Cost reduction is accomplished by marked improvement in subsurface efficiency, reduced well maintenance, practical elimination of rod breakage and, where desirable, a substantial increase in production.

(This original unit is still operating efficiently 24 hours per day after 15 years on the same well.)

Unitized design eliminates costly foundations and makes it unnecessary to disconnect any hydraulic piping to service the well. Among the other Vickers advantages are:

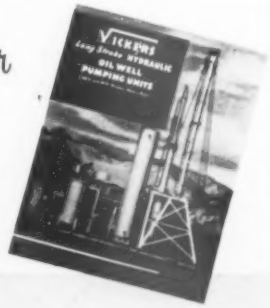
- *20 and 30 ft. stroke with maximum polished rod speed at minimum strokes per minute. (7 and 6 s.p.m. respectively)*
- *fewer reversals*
- *lower range of rod stress*
- *smooth shockless reversals*
- *lower standing valve velocities*
- *more safety features*
- *lower power requirement*
- *easier to operate*

Vickers Hydraulic Pumping Units were the first to feature unitized construction, long stroke, and pneumatic counterbalance. Vickers Units operate day in and day out, year after year with minimum maintenance.

Using standard hydraulic oil as the working fluid, they are self-lubricated and totally enclosed . . . have automatic overload protection.

VICKERS Incorporated
Division of the Sperry Corporation
Petroleum Equipment Department
2160 EAST IMPERIAL HIGHWAY • EL SEGUNDO, CALIF.
Engineers and Builders of Oil Hydraulic Equipment Since 1921

Write for New Bulletin No. 52-51.



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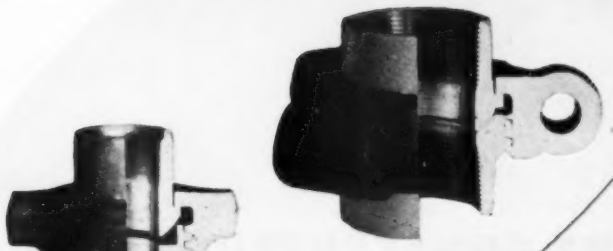

FIG. 100
1000 p.s.i.
SIZES 2", 2½", 3", 4", 6", 8"

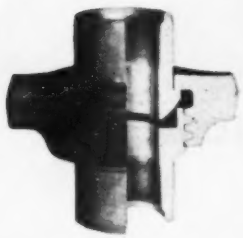

FIG. 600
6000 p.s.i.
SIZES: 1", 1½", 2", 2½", 3", 4"

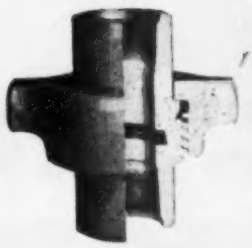

FIG. 1502
15,000 p.s.i.
SIZES: 2", 2½", 3"

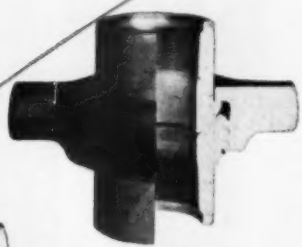

FIG. 400
4000 p.s.i.
SIZES: 2", 2½", 3", 4", 5½" O.D.,
6", 7" O.D., 8", 10"

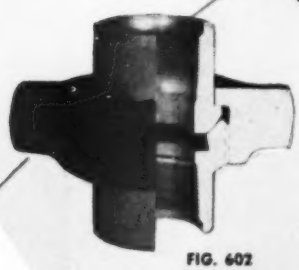

FIG. 602
6000 p.s.i.
SIZES: 1", 1½", 2", 3", 4"

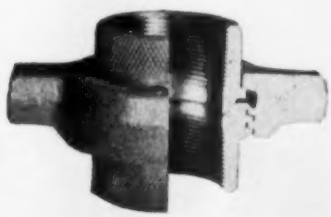

FIG. 200
2000 p.s.i.
SIZES: 1", 1¼", 1½", 2", 2½"
3", 4", 6", 8"

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. . . AND THEY'RE AVAILABLE EVERYWHERE!

It's no wonder WECO Unions are the most popular and widely used by the oil industry. The wide range of types, pressures (1,000 - 15,000 lb.) and sizes (1" through 10") means you can get the right WECO Union wherever they're needed on your drilling rig — your production hook-ups — tank and separator manifolds — field gathering lines, and every other service in the oil field. There are WECO Unions for pump suction line connections, a blanking union for scraper box and jumper assembly service, manifolding, terminal installations and transfer lines.

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WECO
REGISTERED TRADE MARK
UNIONS

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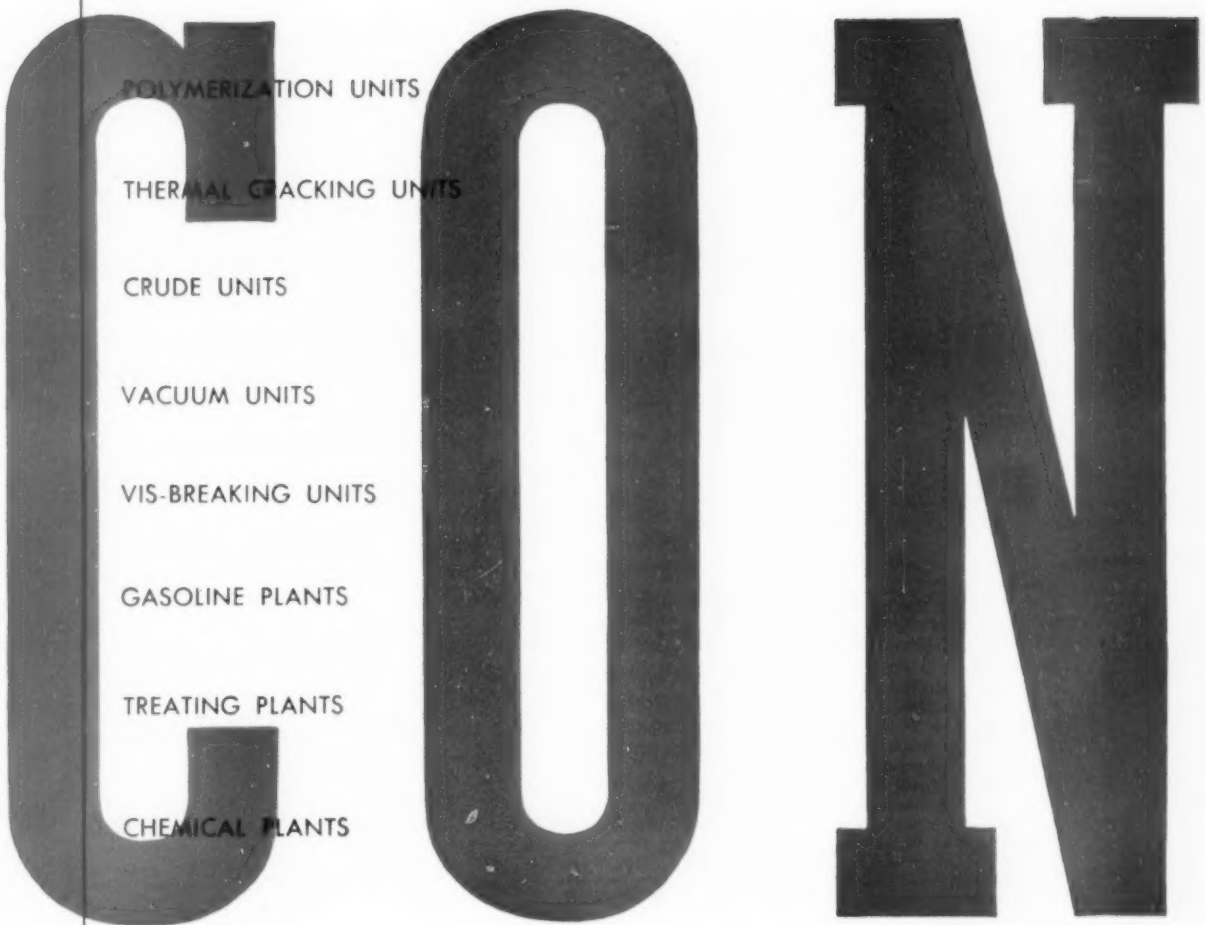

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Spark Plug Life Savers

for

CONTINUOUS DUTY INDUSTRIAL GAS ENGINES

Frequent spark plug re-gapping and replacement, increased "down time" and maintenance costs . . . these are the result of "capacity loading" in the long cables of high tension ignition systems on large industrial gas engines. Each time the spark plug fires, this stored energy discharges rapidly at extremely high current peaks, shortening spark plug life by causing excessive erosion of the electrodes.

American Bosch Spark Plug Life Savers slow the rate of discharge—reduce the harmful effects of excessive current peaks. Ignition stays within specifications, plug life is increased and maintenance costs go *down!*

Try a set of RE 586 Spark Plug Life Savers today . . . Prove their advantages on your 24-hour duty gas engines. You'll agree they're a winning combination for longer plug life and lower maintenance costs. For complete details write to American Bosch Corporation, Springfield 7, Mass.

CUT COSTLY EROSION OF SPARK PLUGS IN 24-HOUR OPERATION

On August 4, a large oil company installed new plugs in a 6-cylinder gas engine running 24 hrs. a day. American Bosch Spark Plug Life Savers were used on cylinders 1, 3 and 5. The table of plug inspection dates and spark gap measurements shows the result: Unprotected plugs needed adjustment at every inspection . . . seven had to be replaced. Plugs with Life Saver protection did not actually need inspection in more than 4 months.

HERE'S PROOF OF *Life Saver* PERFORMANCE

NOW . . . TAKE A LOOK AT THIS RECORD

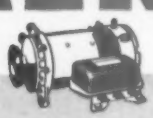
Cylinders 1, 3 and 5 have *Life Savers*—others unprotected

DATE	Cyl. #1	Cyl. #2	Cyl. #3	Cyl. #4	Cyl. #5	Cyl. #6
Aug. 4	.015	.015	.015	.015	.015	.015
Aug. 21	.015	.027	.015	.025	.015	.032
Sept. 10	.015	.033	.015	.026	.016	.038
Sept. 18	.016	.028*	.016	.022*	.016	.030*
Oct. 6	.016	.035	.016	.026	.016	.040
Oct. 19	.017	.030*	.017	.025	.018	.035
Nov. 1	.018	.025	.018	.025*	.018	.030*
Nov. 24	.018	.035	.018	.030	.018	.050
Dec. 14	.018	.040*	.018	.025	.018	.040

Note: Unprotected plugs re-gapped to .015 at each inspection. *—*Plug Replaced.*

AMERICAN BOSCH

Automotive and Aviation Magnetos



Generators and Regulators

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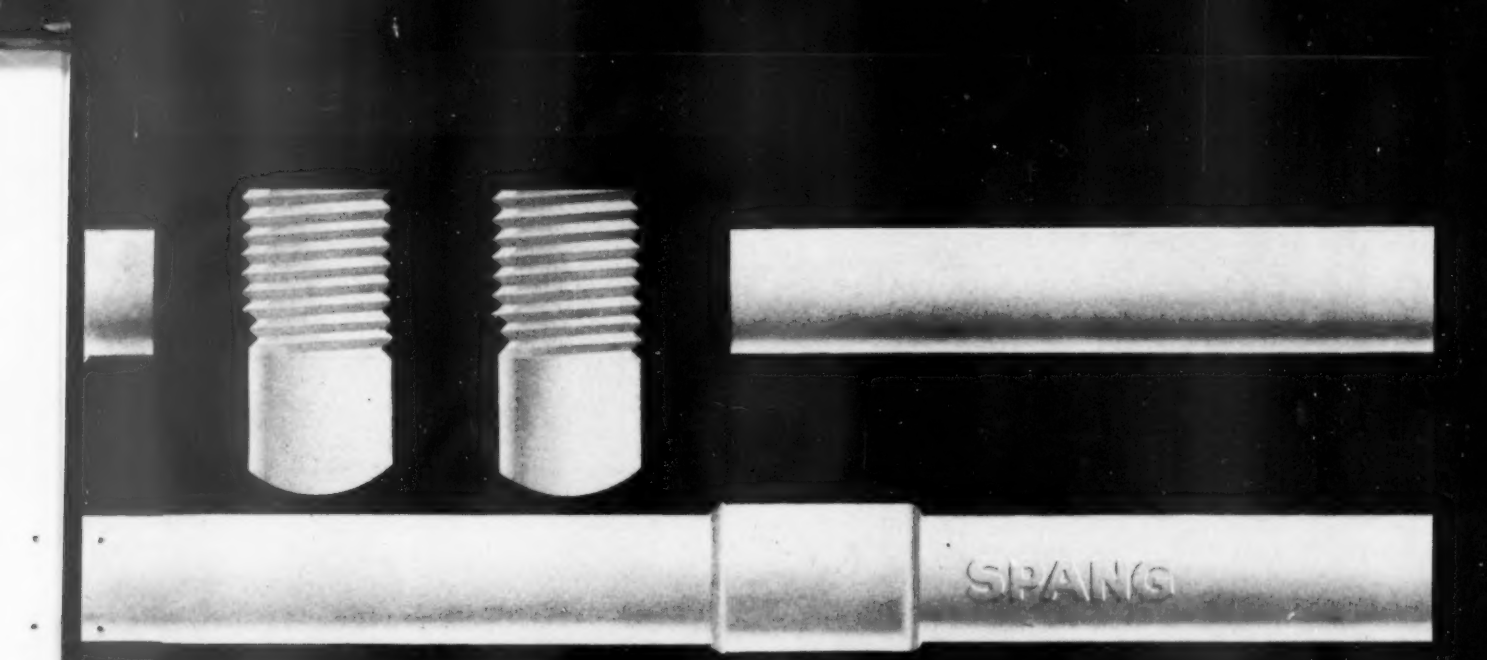
AMERICAN BOSCH

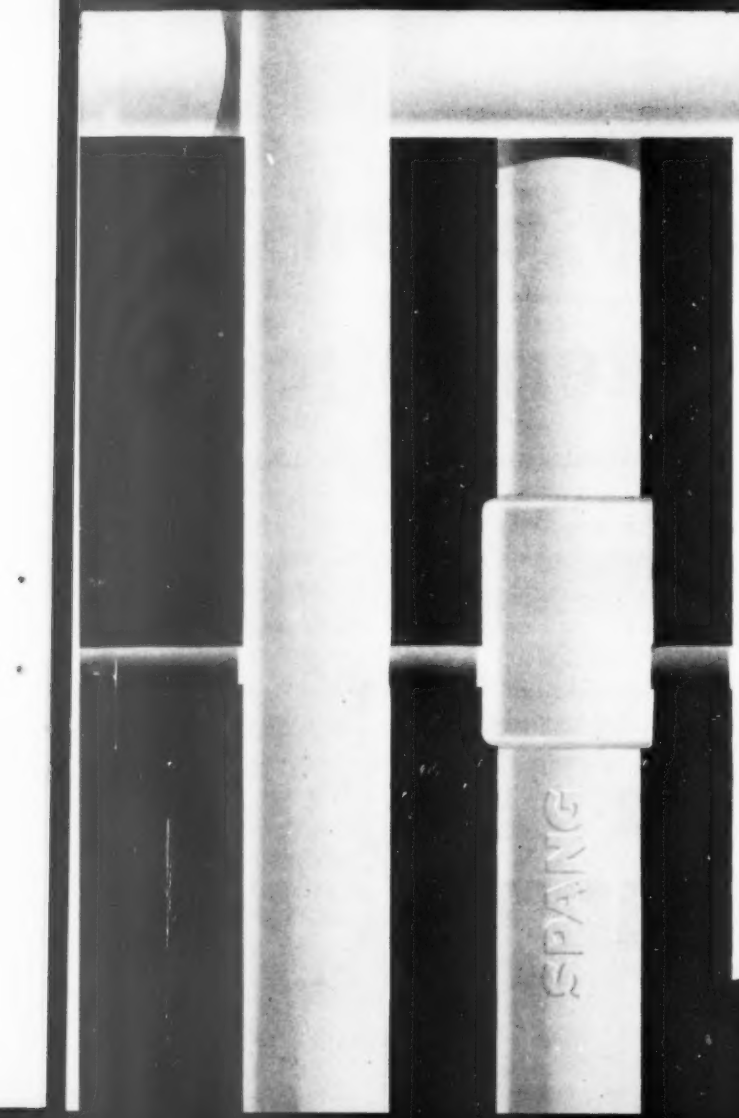
All Electric Windshield Wipers

Ignition Coils

Diesel Fuel Injection Equipment



doubly inspected for triple dependability



SPANG "CW"® STEEL PIPE

After strict metallurgical control during its manufacture, SPANG "CW" is inspected not only once . . . but twice!

Doubly inspected SPANG "CW" assures you of oilfield pipe of triple dependability. First of all, you can depend on the uniformity of SPANG "CW" for easier cutting, bending and threading—faster installation at less cost. Secondly, you can count on SPANG "CW" Steel Pipe for dependable service in oilfield applications—water systems, oil-gathering systems, air lines, gas lines, water flooding lines or salt water disposal lines. And furthermore, you can depend on SPANG "CW" Steel Pipe for an exceptionally long life in the field.

Don't order just *any* pipe . . . get triply dependable SPANG "CW" Steel Pipe, normally available through your local National Supply Store in a complete range of standard sizes.

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SPANG STEEL PIPE · SUPERIOR & ATLAS ENGINES

THE NATIONAL SUPPLY COMPANY NSCO NATIONAL BLUE PRODUCTS

4 WAYS to Guard Against Power Interruption

Here are a few of the many different circuit arrangements Allis-Chalmers can provide. All are designed to assure continuity of service. Each one is specially suited for specific situations.

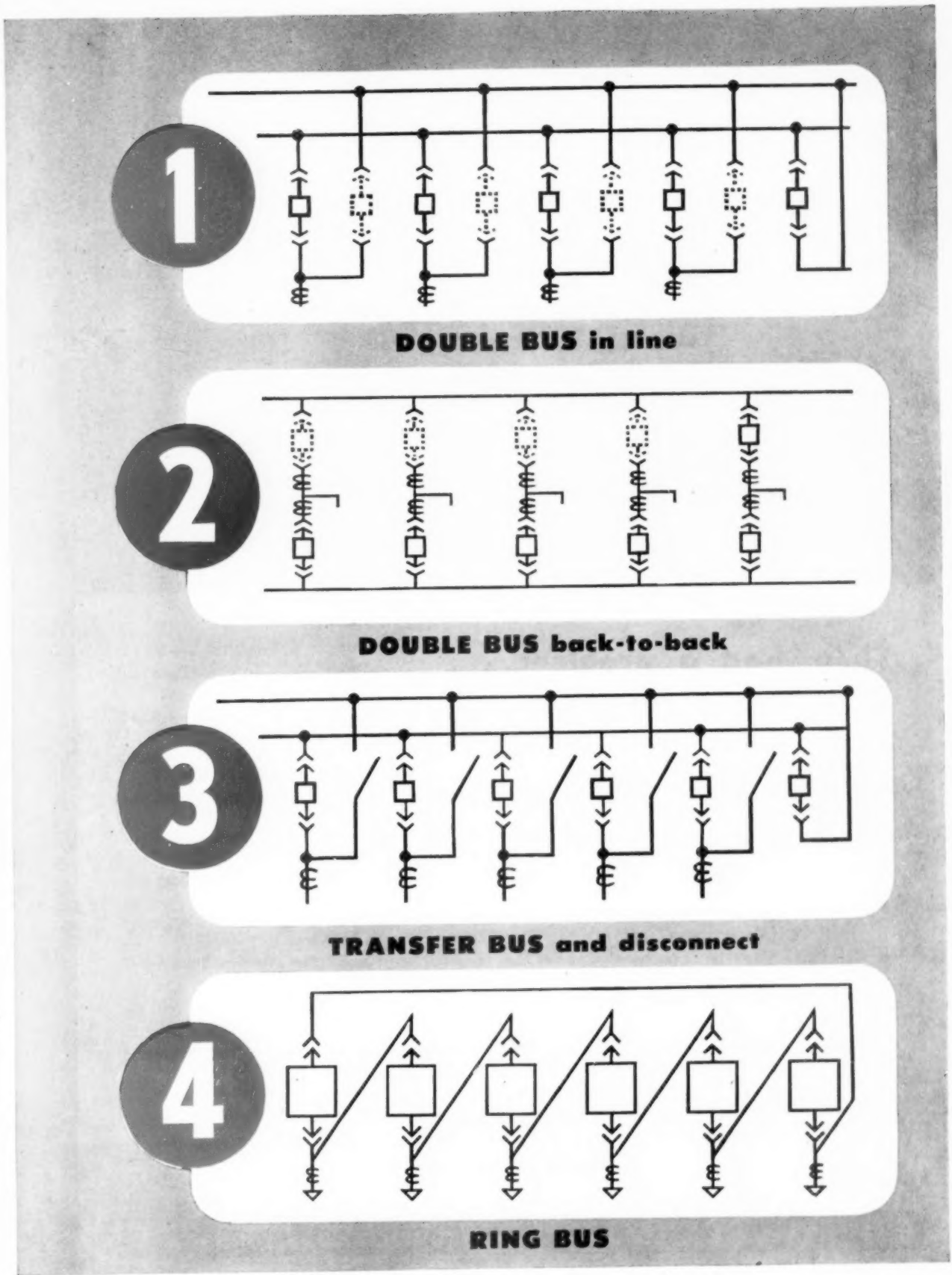
With Allis-Chalmers switchgear, all these circuit schemes have one advantage in common. Each arrangement shown can be built into standard units of Allis-Chalmers metal-clad switchgear without adding extra cubicles. This economy and simplicity, plus the obvious space savings, make Allis-Chalmers equipment especially attractive.

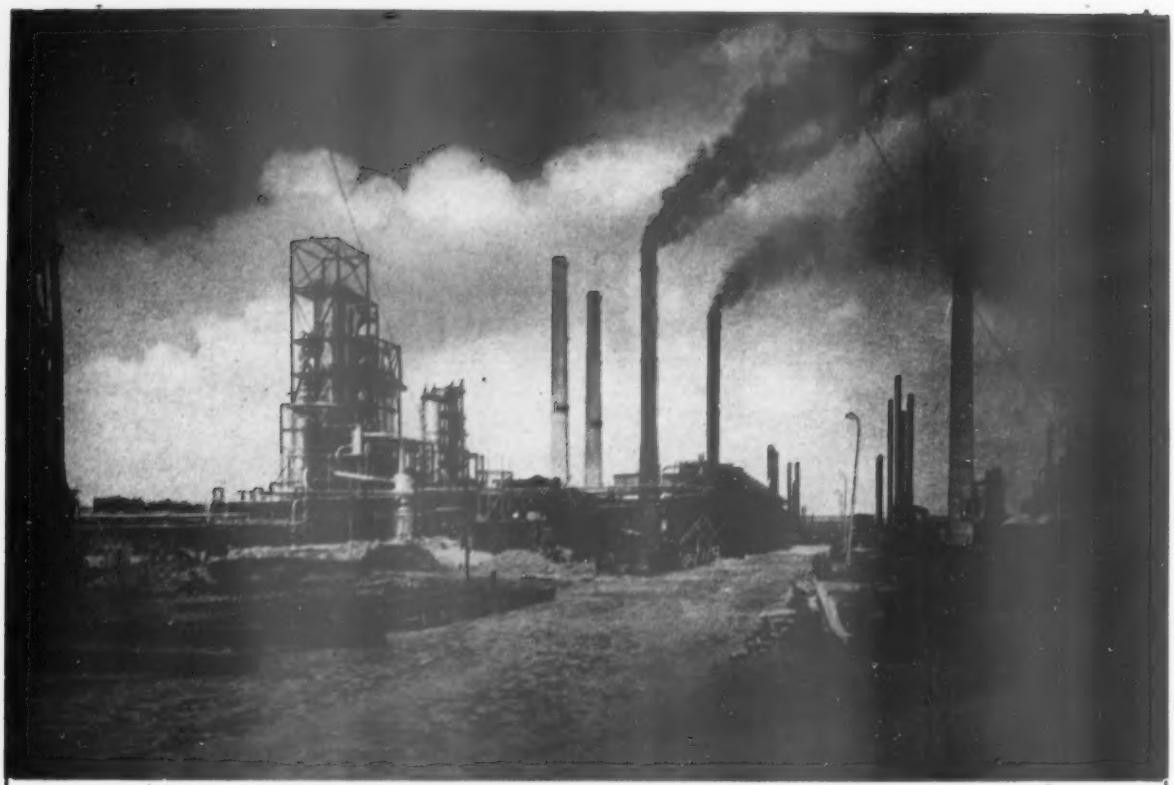
Which Arrangement is Best? A study of your problem is needed to answer this question. Any one of these arrangements may be best for your plant. Or maybe an entirely different scheme is needed. In any case, Allis-Chalmers engineers can help you work out the best scheme for you . . . one that provides ✓ economy, ✓ simplicity, ✓ space saving, and ✓ uninterrupted service.

For complete information, call your nearby A-C district office, or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-4135

ALLIS-CHALMERS

A-C ALLIS CHALMERS


1
DOUBLE BUS in line
2
DOUBLE BUS back-to-back
3
TRANSFER BUS and disconnect
4
RING BUS



They had a problem... When World-War-Number-Two laid waste many of the largest Oil Refineries in Europe, it also left the world pitiably short of new or replacement plant. In fact Global disruption was complete. Oil Companies were hard put to know where to turn for supplies of more and yet more refining plant. Their normal sources of supply — although working at fever pitch, were still saturated with orders that would take years to complete. But the need for plant was urgent. The Royal Dutch Shell Group solved their problem, in part, when they turned to Harveys. For Harveys have one of the most modern and fully equipped works in the world for the fabrication of all kinds of heavy and light plant for the Oil and many other Industries. **In fact Yours the problem – Harveys the answer!**

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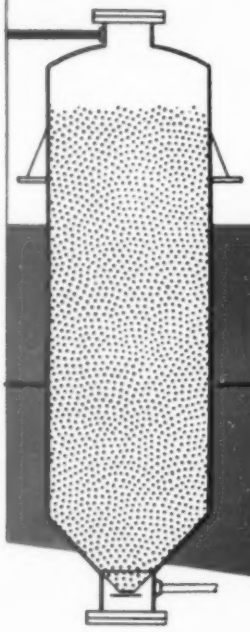
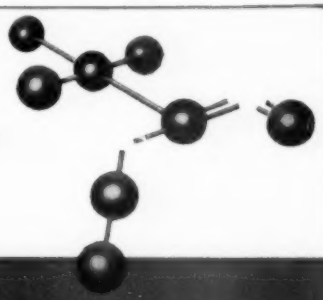


...ready to tackle any sorptive-mineral job that comes along...



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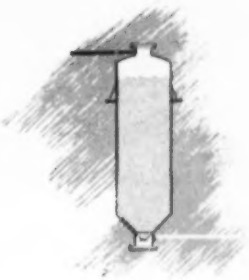

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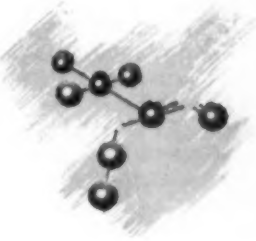
Our sorptive minerals are recognized standards in desulfurization, reforming and isomerization systems—catalytic removal of unsaturates—conversion of sulfides to elemental sulfur—fluid catalyst applications—as catalyst carrier in copper sweetening processes.



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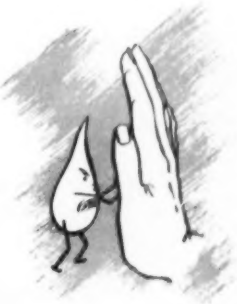
Mine and plant facilities permit prompt and economical production of grades meeting individual customer specifications. Our laboratories and technical staffs are ready to assist in research, development, design and operating problems. Your inquiries are invited.



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FOXBORO REG. U. S. PAT. OFF. — MULTI-RECORD DYNALOG

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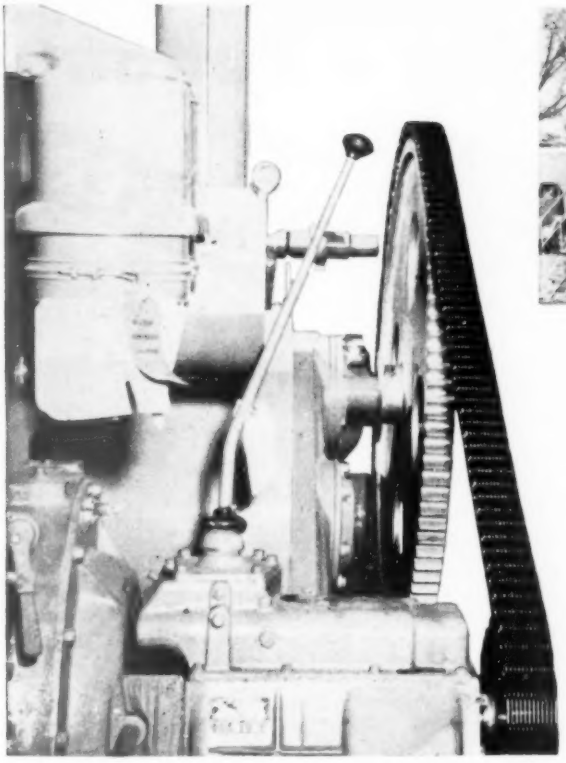

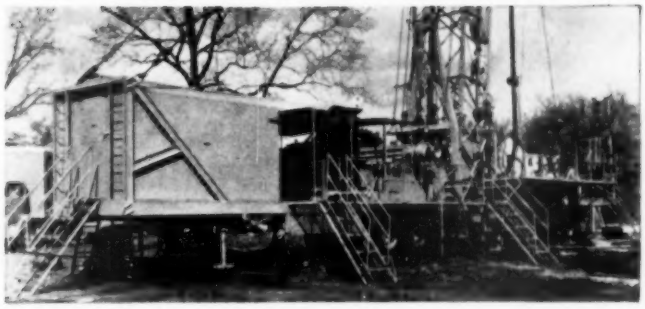

By splitting rig load between two trailers, rig designer met all highway weight restrictions. By using Morse Hy-Vo Drive to power slush pumps, designer kept rig within 8′ road width limits.

View of rig's slender, extra-capacity Morse Hy-Vo Drive which transmits power to slush pump—and opens up a new era of oil-field power transmission. In many instances, Morse Hy-Vo does away with expensive, bulky outboard bearings; permits weight, space savings never before possible.

How a 1½″-pitch x 3″-wide MORSE HY-VO DRIVE helps provide portability in new dual rig!

This new dual-trailer rig incorporates a 96′ mast and working floor in a 60,000 lb., 40′ unit; drawworks, transmission, engine, and doghouse in a 57,000 lb., 37′ unit.

It will work a string of 3½″ drill pipe up to 6500′ long. It's designed to comply with all highway regulations; can be set up on location within two hours after arrival.

One of the big factors in the rig's portability and rigging ease is a slender, tough Morse Hy-Vo Drive running from a WAK Waukesha engine equipped with 3041 Brown lipe transmission to a 7¼ x 10 Gardner-Denver Slush Pump.

At high speeds, the 1½″-pitch x 3″-wide Morse Hy-Vo easily, smoothly, quietly delivers 180 hp. at 5500 fpm., has the extra toughness for handling increased torque when delivering same horsepower at 800 fpm.

Because the Morse Hy-Vo with required capacity was only 3″ wide, both engine and pump could be *permanently* mounted on one skid—within the 8′ wide road limit—thus avoiding necessity of special road permit or disassembly of unit on moving day.

What about *your* high-speed, heavy-duty applications? Think them over, with Morse Hy-Vo in mind. Write for specific information or send coupon for Hy-Vo Catalog.

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Send free 16-page Morse Hy-Vo Drive Catalog immediately. I'm also interested in Morse Roller Chains and Stock Sprockets ☐ Morse Chain Couplings ☐ Morse Flexible Couplings ☐ Morse Radial Couplings ☐ Morse Cable Chain ☐.

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LimiTorque opens and closes any type of valve in a fraction of the time required for hand operation. *It is absolutely dependable and safe,* even when pressures are so *high* that manual operation is almost impossible . . . when valves are exceptionally *hot* . . . or where its location is *hazardous* or *inaccessible.*

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Of course, *LimiTorque* offers a number of "exclusive advantages" in design and construction, which not only give dependable, safe and speedy performance, but which are your *guarantee* against damage to valve stems, seats, discs, plugs, or gates . . . not to mention possible physical injury to operators.

If you have *valve operating problems,* write us —and a "Philadelphia Engineer" will gladly call.

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After sweetening a sour gasoline, Tenamene 2 remains in the sweetened gasoline to provide powerful, efficient protection against gum formation.

No matter what sweetening or inhibiting processes you are now using, the chances are that the use of Tenamene 2 can result in significant savings. For example, using Tenamene 2 may considerably reduce heat costs by cutting recycling time, or it might eliminate costly regeneration of copper or plumbite treating solutions.

If you're interested in general information about gum inhibiting as well as specific data about the Tenamenes, send for the booklets listed in the coupon. Our Petroleum Chemicals Laboratory will be glad to make tests and recommendations on any of your gum inhibiting problems.

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Dope gang preparing a string of A. O. Smith 26-inch welded steel line pipe for lowering in on the West Texas Gulf Pipe Line.

Biggest Inch to carry 381,000 bbl. per day from Permian Basin area

The West Texas Gulf Pipe Line, completed last February, is the largest single carrier of crude oil in this country. It has 465 miles of 26-inch pipe which extends from Colorado City in west Texas to Lucas, just outside Beaumont.

Present capacity of 301,000 barrels per day is being increased to 381,000 by the addition of intermediate pumping stations. Ultimately, capacity can be increased further to an estimated 440,000 barrels per day.

Crude oil from the Permian Basin area, containing more than 20% of the nation's oil reserves, is delivered to the Beaumont area and, through a 20-inch branch of 112 miles, to Longview, Texas, where it connects with other pipe lines serving Great Lakes and Ohio River valley refineries.

A considerable mileage of the 26-inch line is of A. O. Smith welded steel line pipe produced in Milwaukee and Houston. We are proud to have contributed to the construction of this, the Biggest Inch, as we have also to virtually every important petroleum products pipe line in the world.

A. O. Smith Line Pipe is available in a complete range of sizes and wall thicknesses, from 8⅝-in. to 36-in. diameters.

FIRSTS by A. O. Smith: Welded line pipe • Internally expanded pipe • Light-wall large-diameter pipe • World's largest producer of large-diameter welded steel pipe.

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STRENGTH—To resist today's high drilling pressures...

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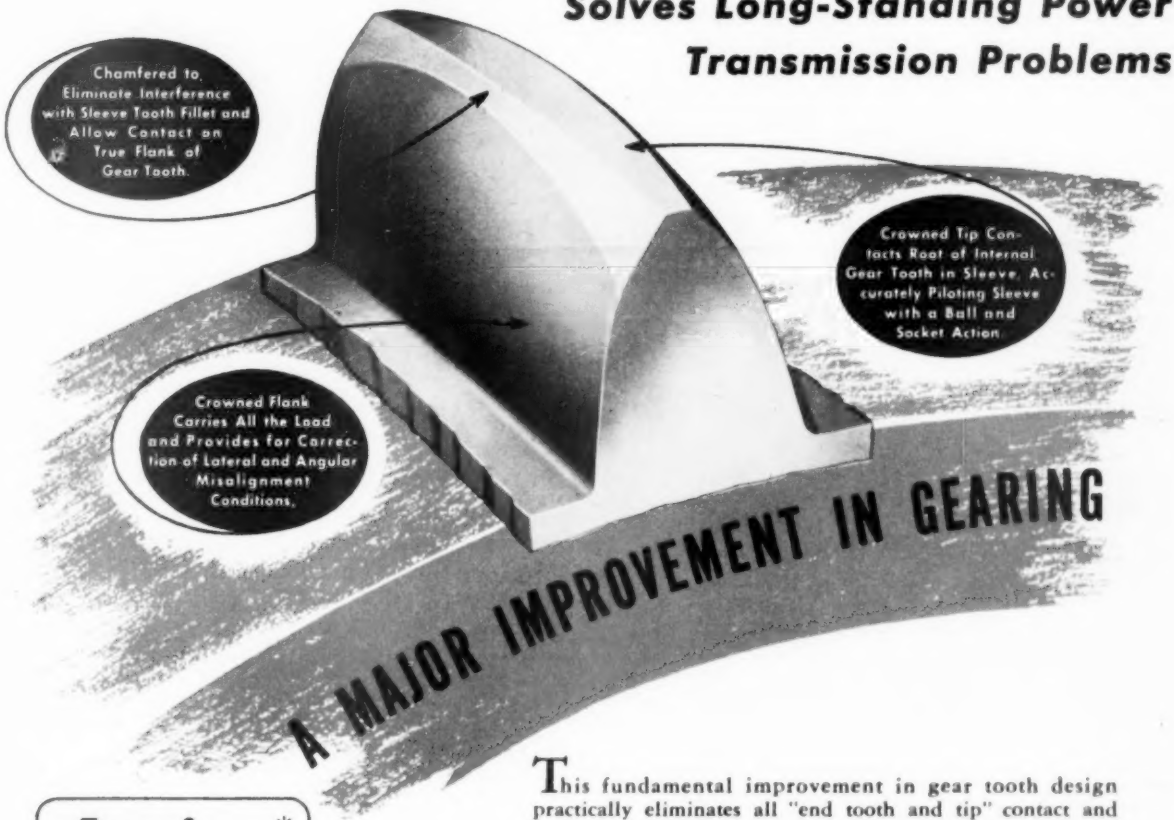
AVAILABILITY—Through Continental's many Field Stores.

THE Amerigear* FULLY CROWNED TOOTH DESIGN

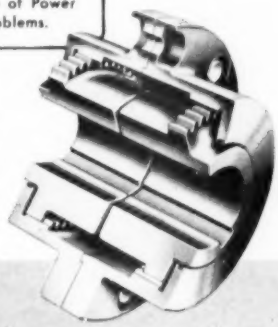
*Trade Mark Reg.

Solves Long-Standing Power Transmission Problems


Chamfered to Eliminate Interference with Sleeve Tooth Fillet and Allow Contact on True Flank of Gear Tooth.
Crowned Tip Contacts Root of Internal Gear Tooth in Sleeve, Accurately Piloting Sleeve with a Ball and Socket Action.
Crowned Flank Carries All the Load and Provides for Correction of Lateral and Angular Misalignment Conditions.
A MAJOR IMPROVEMENT IN GEARING

Amerigear*

Fully Crowned Tooth Design Solves Wide Range of Power Transmission Problems.



Oil Seals of Amerigear Couplings Are As Advanced in Design, Performance, and Effectiveness As Is the Amerigear Fully Crowned Tooth.

This fundamental improvement in gear tooth design practically eliminates all "end tooth and tip" contact and provides greater freedom of axial movement. These and other exclusive advantages of Amerigear Couplings distinguish them from common gear-type couplings. There are numerous instances where the fully crowned tooth design of Amerigear Couplings has been utilized to simplify power transmission mechanisms and add reliability to performance in a measure heretofore considered impossible.

Amerigear Couplings offer many more advantages than are obtainable with common basic designs. If your problem arises from excessive offset or angular misalignment, tight backlash requirement, space limitations, high speeds and loads, or any combination of these, it can be solved by the use of Amerigear Couplings. Amerigear Engineers are available for consultation.

Comparison of Amerigear Fully Crowned Tooth Design With Gearing of Conventional Gear-Type Couplings Shows How "End Tooth and Tip" Contact Is Practically Eliminated and Why Greater Freedom of Axial Movement Is Provided by Amerigear Fully Crowned Tooth Design (dotted lines indicate gear teeth of conventional gear-type coupling.)

AMERICAN FLEXIBLE COUPLING COMPANY

ERIE, PA., U. S. A. ***Originator of the Amerigear Fully Crowned Tooth***

Sales Offices in Principal Industrial Centers

In Canada: Canadian Zurn Engineering, Ltd. • 2052 St. Catherine St. W., Montreal 25, P. Q. Canada

American Flexible Coupling Co., Erie, Pa., U. S. A.
Please send me further information regarding AMERIGEAR COUPLINGS with the Fully Crowned Teeth and Catalog No. 501.

Name ..... *Title* .....

Company .....

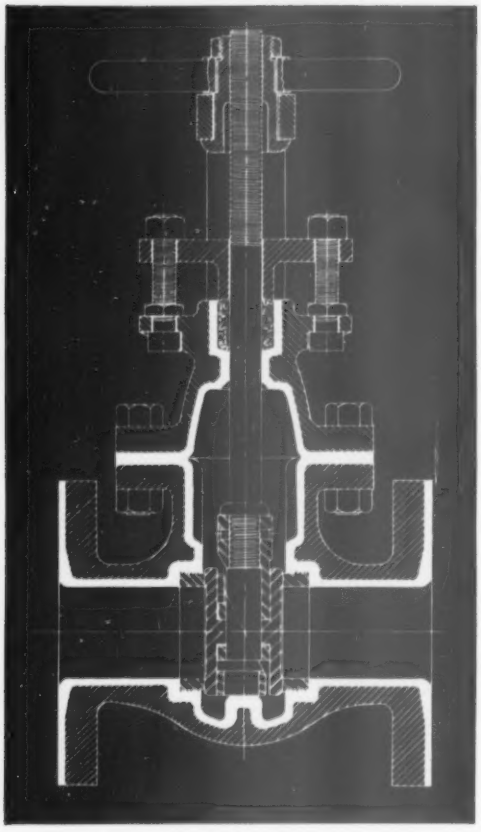
Address .....

City ..... *State* .....

Please attach to your business letterhead.

HANDLING CORROSIVE FLUIDS?

this unique hard rubber lined iron body gate valve offers big savings in many corrosive services . . .



Darling 150-pound rubber lined gate valve, with outside screw and yoke, featuring unique parallel seat, fully revolving disc principle. Plain "no pocket" discs prevent accumulation of sediment. Darling rubber lined gate valves can be furnished only in rising stem, cylinder or motor operated; or quick-opening types.

WHEN Darling gate valves of this type go to work, you gain *multiple* advantages sure to save you money *and* time.

First, you gain big initial savings because these rubber lined iron body gate valves (ideal for many corrosive services not exceeding 180° F.) are much less expensive than special alloy valves. Moreover, Darling's special bonding technique permanently prevents separation of the hard rubber lining from the valve body.

All interior working parts are made of alloys suitable for the corrosive conditions encountered.

Secondly, and equally attractive, is Darling's exclusive *fully revolving double disc, parallel seat* feature! In a nutshell this means drop-tight closure where most other valves would fail. It also assures unmatched life with a very minimum of attention and maintenance.

Here's a combination you just can't beat! Before you buy gate valves of *any* type, get acquainted with these unique Darling valves and their operating details. Get *all* the facts.

Write today for free bulletin describing Darling rubber lined gate and check valves.

DARLING VALVE & MANUFACTURING CO.
Williamsport 1, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario

DARLING VALVES FOR EVERY NEED

Darling parallel seat revolving disc gate valves are available in a wide range of sizes and constructions for all kinds of normal and unusual service, and for pressures up to 1500 pounds. In addition to rubber lined, iron body valves, corrosion resistant types include plain iron body with special alloy trim, cast steel, all bronze, special alloys or combinations as required. We'll gladly furnish specific recommendations on the proper valves for your particular service.

FOR PLUS VALUES, JOB-PROVED AGAIN AND AGAIN

In A Fire Emergency..

ALL HANDS ARE "SKILLED HANDS"

WITH **ANSUL** DRY CHEMICAL
FIRE EXTINGUISHING EQUIPMENT

With Ansul Extinguishers near-expert results are obtained by inexperienced operators. In fact, all Ansul Extinguishers are designed to provide a maximum of extinguishing effectiveness in the hands of inexperienced personnel.

This feature, plus benefits listed below, account for the outstanding preference for Ansul Equipment by fire protection men in all phases of industry the world over.

1. Water-tight construction throughout.
2. Easy on-the-spot Recharging (No tools needed.)
3. Quick, positive puncture operation.
4. Special cartridge guard protects cartridge . . . rugged construction throughout.
5. Ansul *"PLUS-FIFTY"* Dry Chemical used exclusively.
6. Corrosion resistant construction throughout.
7. Greater fire-stopping power.
8. Field tested by thousands of satisfied customers.

Send for File No. A-110. You will receive a variety of helpful printed matter. Included is our latest catalog which describes Ansul Extinguishers of all sizes — from the small Ansul Model 4 to Ansul Piped Systems and Ansul 2000 lb. Stationary Units.

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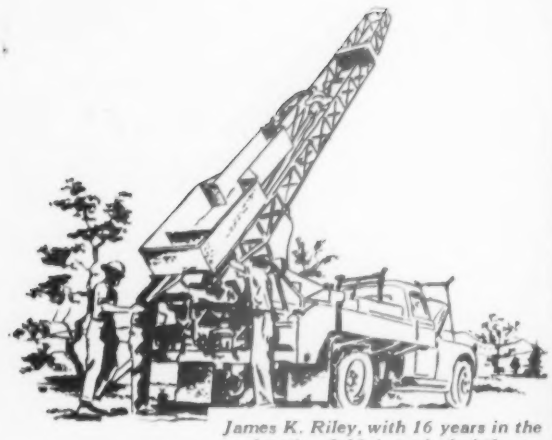
FIRE EQUIPMENT DIVISION • MARINETTE, WISCONSIN

MANUFACTURERS OF DRY CHEMICAL FIRE EXTINGUISHING EQUIPMENT, REFRIGERATION PRODUCTS, INDUSTRIAL AND FINE CHEMICALS AND LIQUEFIED GASES.



James K. Riley, with 16 years in the exploration field, is typical of the experienced party chiefs at IX. With Independent for 12 years, he has developed the knowledge necessary for obtaining profitable results.

Independent's "MEN WITH RESPONSIBILITY"

Average 16 Years Experience

The success of your geophysical surveys depends largely upon the experience of the Party Chief. Independent's Party Chiefs have an average of 16 years experience in the exploration field. This experience helps you to realize more profits from your geophysical surveys.

Since 1932 Independent has been making successful surveys in 26 states and foreign countries. One of the oldest exploration contractors in the business, Independent has served more than 100 important oil producers.

POINTING THE WAY FOR THE DRILL

IXC

Independent's Experience Merits Your Confidence

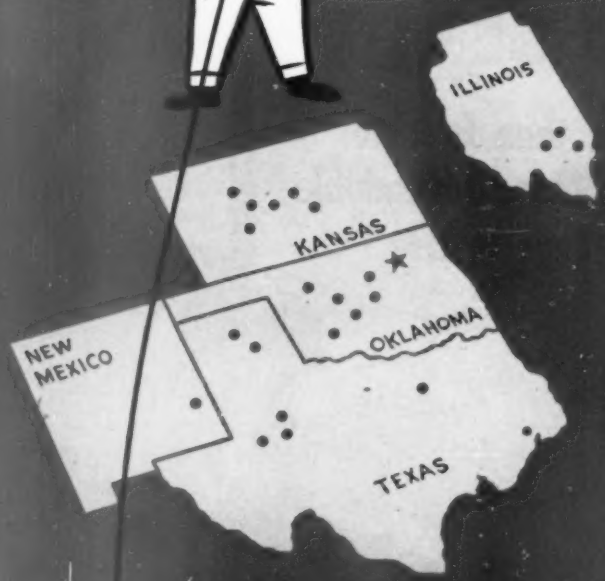
Independent *Geophysical Surveys*

EXPLORATION COMPANY

1973 WEST GRAY ★ HOUSTON, TEXAS

ESTABLISHED 1932

Just call Bovaird!



To get WHAT you want
WHERE you want it
WHEN you need it!

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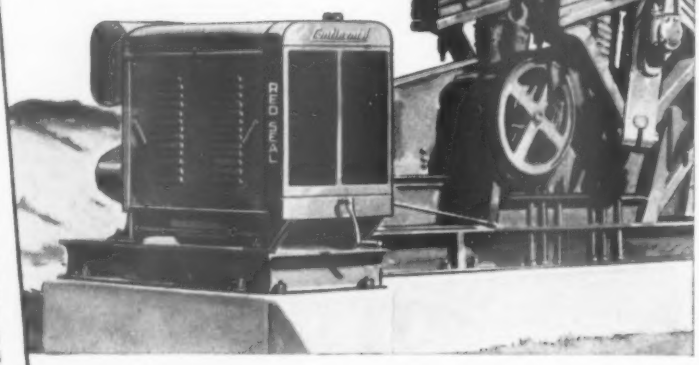
THE Bovaird SUPPLY COMPANY
GENERAL OFFICES
TULSA, OKLAHOMA

82 YEARS OF PROGRESS WITH THE OIL INDUSTRY

Ask for it at your Supply Store ...CONTINENTAL RED SEAL POWER

Easier than Ever to Buy...More Dependable than Ever to Use



INDUSTRIAL GASOLINE ENGINES

Model	Cyl.	Bore	Stroke	Displ.	Bare Engine H.P.
N56	4	2¼	3½	56	14.2 @ 2200 RPM
N62	4	2⅛	3½	62	15 @ 2200 RPM
Y69	4	2⅛	3½	69	21.4 @ 2400 RPM
Y91	4	2⅞	3½	91	28.5 @ 2400 RPM
Y112	4	3 1/16	3½	112	32 @ 2400 RPM
F124	4	3	4⅛	124	36 @ 2400 RPM
F140	4	3 1/16	4⅛	140	42 @ 2400 RPM
F162	4	3 1/16	4⅛	162	49 @ 2400 RPM
F186	6	3	4⅛	186	60.5 @ 2400 RPM
F209	6	3 1/16	4⅛	209	68 @ 2400 RPM
F226	6	3 1/16	4⅛	226	73 @ 2400 RPM
F244	6	3 1/16	4⅛	244	79 @ 2400 RPM
M271	6	3⅜	4½	271	86.2 @ 2400 RPM
M290	6	3⅜	4½	290	92.2 @ 2400 RPM
M330	6	4	4½	330	104.4 @ 2400 RPM
B371	6	4⅛	4½	371	110 @ 2400 RPM
B427	6	4 5/16	4⅛	427	127 @ 2400 RPM
J382	4	4½	6	382	78.3 @ 1500 RPM
G134	4	3⅛	4⅛	134	32.2 @ 2000 RPM
G157	4	3⅜	4⅛	157	37.7 @ 2000 RPM
H227	4	3⅜	5½	227	54 @ 2000 RPM
H243	4	3¼	5½	243	58.2 @ 2000 RPM
*H260	4	3⅜	5½	260	62 @ 2000 RPM
T371	6	4⅛	4⅝	371	119 @ 2400 RPM
T427	6	4 5/16	4⅛	427	140 @ 2400 RPM
U501	6	4½	5¼	501	160 @ 2400 RPM
R513	6	4½	5⅛	513	164.3 @ 2400 RPM
R572	6	4¾	5⅛	572	182.4 @ 2400 RPM
R602	6	4⅞	5⅛	602	191.7 @ 2400 RPM
S749	6	5⅛	5½	749	217 @ 2200 RPM

INDUSTRIAL DIESEL ENGINES

Model	Cyl.	Bore	Stroke	Displ.	Bare Engine H.P.
GD157	4	3⅜	4½	157	39 @ 2000 RPM
HD243	4	3¼	5½	243	54.7 @ 2000 RPM
*HD260	4	3⅜	5½	260	59.3 @ 2000 RPM
TD427	6	4 5/16	4⅞	427	106.5 @ 2000 RPM
RD572	6	4¼	5⅛	572	142.5 @ 2000 RPM
SD802	6	5 5/16	5½	802	184.3 @ 1800 RPM

*Available for Industrial applications only.

Now add *accessibility* to the many other good reasons for standardizing on Red Seals for oil field jobs within their power range. That range is a broad one, too: look at the list at left. It includes models for use on all standard fuels—each the product of more than 50 years' engine-building experience—each backed by parts and service facilities coast to coast.

CONTINENTAL MOTORS · Powerful as the Nation · AMERICA'S STANDARD

6218 CEDAR SPRINGS ROAD, DALLAS 9, TEXAS • 3817 S. SANTA FE AVE., LOS ANGELES 58, CALIF. • 910 S. BOSTON ST., ROOM 1008, TULSA, OKLA. • 1819 BROADWAY, NEW YORK 23, NEW YORK • 1252 OAKLEIGH DRIVE, EAST POINT (ATLANTA) GA.

Continental Motors Corporation

MUSKEGON, MICHIGAN

You can't beat *CARBIDE*

as your supplier of these chemicals!

So *many* plants dehydrate or desulfurize natural gas by these methods. Why?—Because you can't beat the initial low cost of the glycol or amine plants—nor their economy and simplicity of operation. If you are constructing a new plant or are replacing, modernizing, or enlarging your present facilities, be sure to consider these glycols and amines!

During 20 years as a supplier to the natural gas industry, we have gathered much experience with these amines and glycols. For information about their properties or use, just call or write your nearest CARBIDE representative. CARBIDE maintains warehouse stocks of these gas-treating chemicals near most of the major gas fields to assure you prompt delivery.

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When you need...

VERSATILE ...RELIABLE ...Low Cost Boat Power

EVINRUDE
OUTBOARD MOTORS

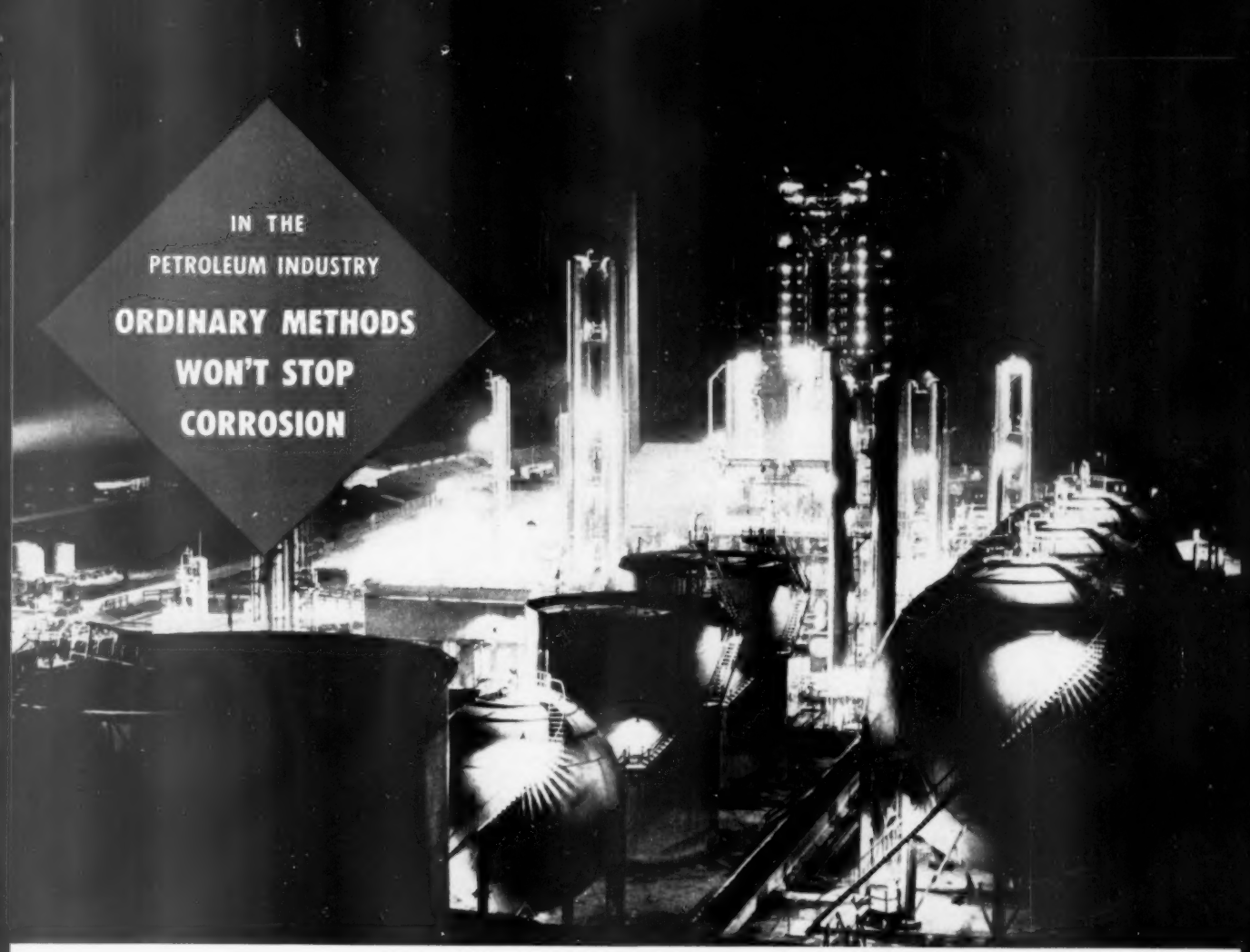
LOOK SHARP at the savings when you power *any* type of boat with an Evinrude instead of an inboard engine. *Low initial cost* . . . and that cost is *all!* No expensive installation work—no accessories—no "extras"—all of which can easily total more than the original engine cost.

More important, look at the *advantages.* Complete portability. Motors can instantly be transferred from boat to boat. No sacrifice of hull space. Utmost simplicity of operation and servicing. Safe and efficient running in shoalest waters. Complete maneuverability with gearshift which provides Neutral, Forward, Reverse.

Wherever power requirements are under 30 H.P., Evinrudes are the logical choice. For literature describing the complete Evinrude line, write EVINRUDE MOTORS, Dept. C, 4264 N. 27th St., Milwaukee 16, Wis.

In Canada: Manufactured by Evinrude Motors, Peterborough, Ontario.

26-ft. waterfront work boat employed in ferrying and general utility service. Carrying capacity up to 8 tons. Speed, to 15 m.p.h. with 25 H.P. Evinrude, depending on load. An exceptionally capable and useful craft.



SPECIFY THE AMERCOAT METHOD— Designed to Give You *PLUS* PROTECTION

Ordinary methods for controlling corrosion usually produce the ordinary results—rapid paint failure, costly replacements, product contamination, excess down-time, and hampered production. Halfway measures and the use of one or two general purpose coatings simply cannot provide adequate protection against corrosion's ceaseless attack.

Amercoat gives you a proven method of corrosion control, assuring you proper protection through these PLUS features:

1. Careful analysis by a trained engineer of all the conditions present in each corrosion problem.

2. The ONE best recommendation for the particular problem. AMERCOAT is a complete line of coatings, each formulated to solve or control specific corrosion problems.

3. On-the-job assistance to your applicators and supervisors by a trained engineer. The AMERCOAT method ensures proper attention to surface preparation and application techniques for maximum protection.

4. Complete stocks of fresh materials always near you at one of AMERCOAT's five regional warehouses or more than 20 franchised distributor warehouses throughout the United States.

5. Service based on experience. The AMERCOAT method of corrosion control is the result of nearly 20 years' experience in solving or controlling corrosion problems in every major industry throughout the United States.

Write today for the name and address of the AMERCOAT representative in your area. At no obligation, he will gladly help you analyze your corrosion problems and evaluate your present control measures. If it is determined that you have a problem within our scope of experience, he will outline a complete program of AMERCOAT's PLUS protection for your plant or equipment.

Amercoat CORPORATION

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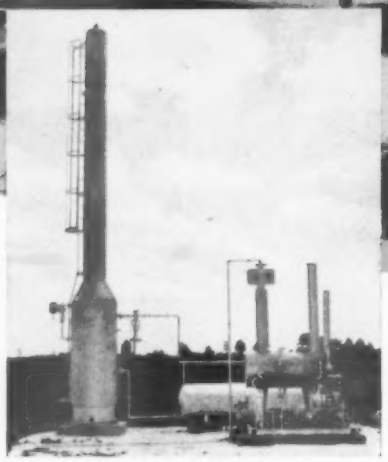
Jacksonville, Fla.
Houston, Texas

Here's How . . .

BS&B's Glycol Injection System of Low Temperature Separation with STABILIZER*



* Patented and Patents Pending

Solved One Lease Operator's Problem!

An Actual Case History From Our Files:

BS&B's Glycol Injection System of Low Temperature Separation with Stabilizer greatly extends the life of old wells, and makes both old and new wells more trouble-free and profitable to operate. Your BS&B Man will gladly give you more details . . . or we'll send you complete information on request.

PROBLEM: This Louisiana operator† of two adjacent leases was losing valuable revenue in the form of condensate by piping "wet gas" directly into the transmission pipeline. In addition, during winter operations, hydrate formation resulted in reduced gas flow due to freezing and plugging of the lines.

SOLUTION: Two BS&B Glycol Injection Low Temperature Separation Units were installed—one to handle the gas production from each lease. A single BS&B Stabilizer serves both units.

RESULT: Hydrate formations are now eliminated. Sales gas and condensate are now separated at low temperatures, and *41% more condensate* is now being recovered and stabilized to remain in the stock tanks. Operator's revenue substantially increased!

†*Name supplied on request.*

EFFICIENCY BS&B RELIABILITY OVER 60 YEARS

BLACK, SIVALLS & BRYSON, INC.

Oil & Gas Equipment Division, Dept. 1-A11

1708 West Main Street — Oklahoma City, Oklahoma

Rigid testing of *Explosion-Proof* CONDULETS*

assures safety and long dependable service

Crouse-Hinds extensive laboratories and modern manufacturing combine to give you top quality

Laboratory testing is one of the key operations in the production of electrical equipment of the highest quality. Crouse-Hinds laboratories are equipped with the latest scientific instruments and staffed with expert technicians.

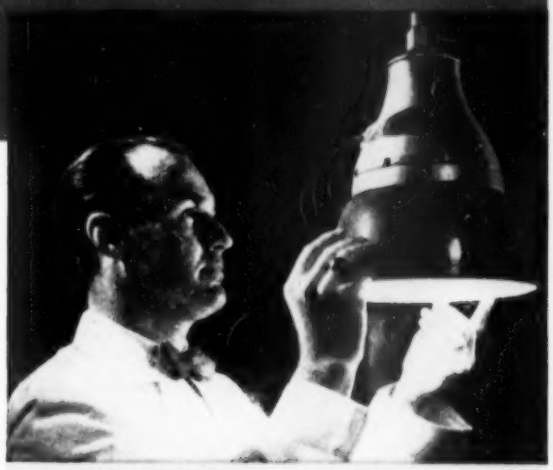
Products are constantly tested to make sure that they are being made to withstand field conditions. New devices are tested to predetermine their meeting or surpassing the requirements of Underwriters' Laboratories.

The photographs at the right show three of the many testing operations that are done in the Electrical Laboratory. It is equipped with apparatus for making both alternating and direct current tests, heat tests, pressure tests and many others.

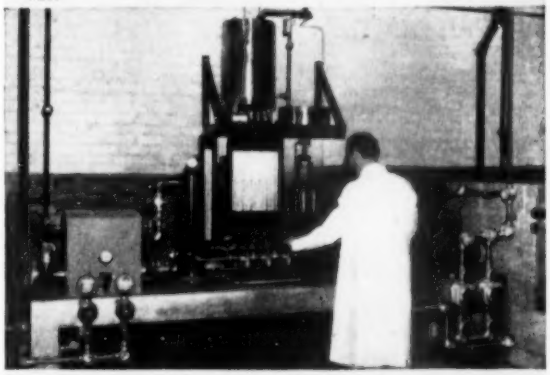
Close cooperation between Crouse-Hinds laboratories and manufacturing departments is one of the reasons why Condulets have been the "Standard of Quality" for nearly fifty years.

Specify CONDULETS on every job. They're made right . . . to serve you better . . . and last longer.

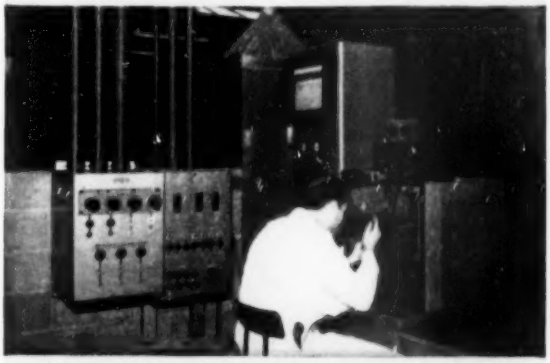
When quality counts
. . . you can count on Condulets



Probing for maximum exterior operating temperature on a Type EVA Explosion-Proof Lighting Fixture using a multiple point recording potentiometer.



Adjusting carburetors and flow meters to create a predetermined explosive mixture within an explosion-proof Condulet for an explosion test.



Photographing the pressure wave in the Oscilloscope to determine the maximum explosion pressure within an explosion-proof Condulet that is behind the concrete wall.

CROUSE-HINDS COMPANY
Syracuse 1, N. Y.

OFFICES Birmingham — Boston — Buffalo — Chicago — Cincinnati — Cleveland — Dallas — Denver — Detroit — Houston — Indianapolis — Kansas City — Los Angeles — Milwaukee — New Orleans — New York — Philadelphia — Pittsburgh — Portland Ore. — San Francisco — Seattle — St. Louis — St. Paul — Tulsa — Washington. RESIDENT REPRESENTATIVES Albany — Atlanta — Baltimore — Charlotte — Corpus Christi — Reading Pa. — Richmond Va. — Shreveport
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CONDULET — First in the field — STANDARD OF QUALITY

*CONDULETS are made only by CROUSE-HINDS

A Nationwide Distribution Through Electrical Distributors

CONDULETS · TRAFFIC SIGNALS · AIRPORT LIGHTING · FLOODLIGHTS

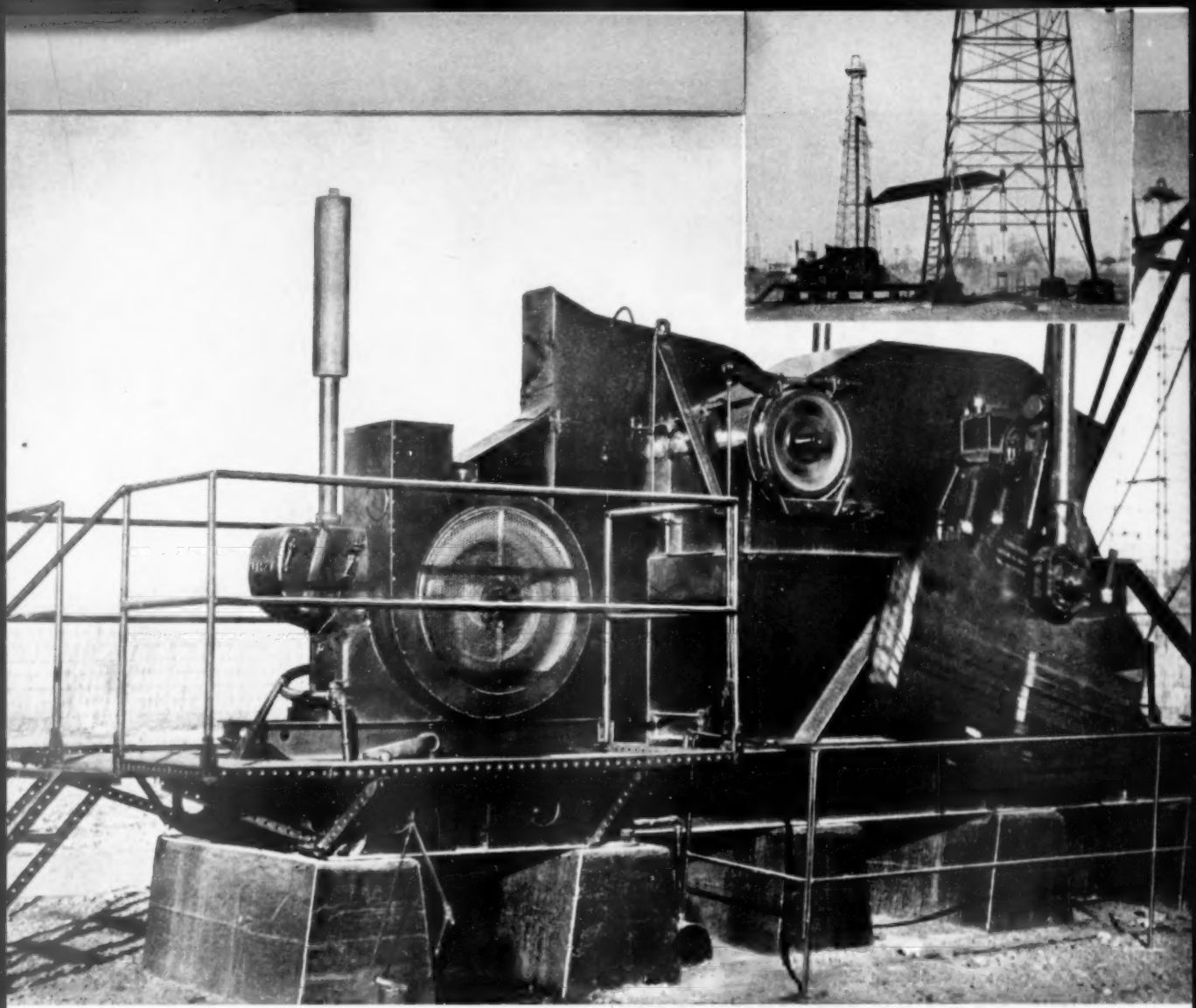
LeRoi A288's do it again!...

...prove that they pump oil

– longer
– at less cost
– with less maintenance

than any other well-pumping engines!

See for yourself



Cost per HP-hour only half

of what major oil company considers good for engines on well-pumping service

Installation No. 1

Le Roi A288 pumped 50 barrels water, 70 barrels oil from 6,475 feet with an estimated load of 11-12 HP.

A288 operated for 1078 24-hour days — without being overhauled!

Operating cost per day — including pumpers' wages, fuel, and maintenance — only 90 cents!

Installation No. 2

Le Roi A288 pumped 180 barrels water, 10 barrels oil from about 6,475 feet with a load of 18 HP.

A288 operated for 911 24-hour days. Maintenance cost was only $.0017/HP-hr.

Operating cost per day — including pumpers' wages, fuel, and maintenance — only 69 cents!

That's real dependability! And economy! It's the kind of profitable performance Le Roi A288 owners in every producing area get every day.

And it's performance *you*, too, can have. See your supply house or Le Roi distributor — ask them to show you A288 installations. And have them tell you the reasons why the A288 is the only engine to be recommended by one major pumping-engine user for continuous service unattended for up to two weeks at a time!

LE ROI COMPANY

A Subsidiary of Westinghouse Air Brake Co.

MILWAUKEE 14, WISCONSIN

Plants: **Milwaukee • Cleveland • Greenwich, Ohio**

Oil Field Headquarters: **Tulsa, Oklahoma**

Service as Near as Your Telephone

Complete parts stocks
Skilled mechanics on 24-hour call
Unexcelled overhaul facilities

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Le Roi Company Branch—Tulsa.
Carson Machine & Supply Co.—Oklahoma City.

East & South Texas, Gulf Coast
Southern Engine and Pump Company—Houston, Kilgore, Edinburg, Dallas, San Antonio, Corpus Christi, Texas, and Lafayette, Houma, New Orleans, Louisiana.

North & West Texas, New Mexico
General Machine & Supply Co.—Odessa, Snyder, Texas.
Nortex Engine & Equipment Co.—Wichita Falls, Texas.

Kansas
Carson Machine & Supply Co.—Great Bend.

Illinois — Western Kentucky
Western Machinery & Engine Company—Centralia, Illinois and St. Louis, Missouri.

Michigan
Hafer Engine Service—Reed City.

Rocky Mountain Area
Gehring Equipment Co.—
Casper, Wyoming, Rangely, Col.

Mississippi, Arkansas and Northern Louisiana
Ingersoll Corporation—Shreveport, Louisiana, El Dorado, Arkansas and Clarksdale, Jackson, Mississippi.

West Coast
Le Roi Engine Sales Co.—
Long Beach, California.

Appalachian Area
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Canada
Luey Export Ltd.—Calgary, Edmonton, Alberta.

P-120

they pick it ON PERFORMANCE

Cutler-Hammer

"Oil Country"

Control

Steadily the preference for Cutler-Hammer Oil Well Pumping Control grows. Its performance *proves* it is the genuine Oil Country Control . . . built to oil men's practical specifications not only to start, stop and protect motors and equipment . . . but built to stop the oil country enemies of performance in their tracks.

Aluminum coated cases bounce back the sun's heat. Chimney-draft type ventilation sucks off heat, sucks in cooler air. (You never see a C-H Control cover door propped open to keep it running.) "Out in the open" contacts stay cooler, and, being vertical, shed dust. Ventilator openings are screened, louvred and baffled to keep out dust and dirt and bugs. Neoprene gasketing shields the timer. Excess clock motor torque keeps it ticking along.

Optional 3-coil overload protection ends single phasing; standard 2 coil suffices where single phasing is not a problem.

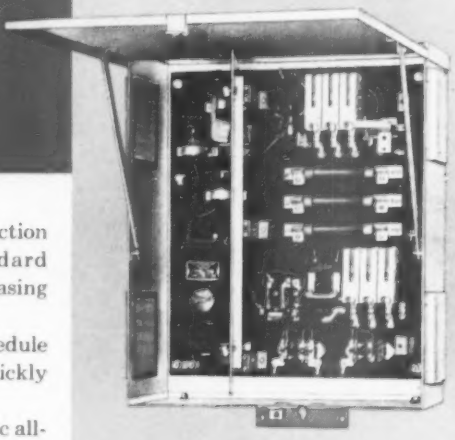
Any type of pumping schedule plus day omission is easily, quickly available.

There's manual or automatic all-at-once or time delay staggered starting available.

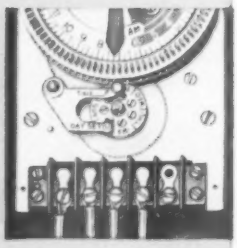
Lightning arrestors protect but don't blow up the works when they pop.

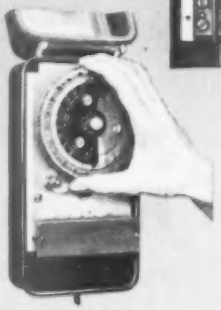
There's every reason in the world for this control's increasing popularity . . . *every reason in the world for you to investigate it too. You'll be glad you did.* CUTLER-HAMMER, Inc., 1453 St. Paul Avenue, Milwaukee 1, Wisconsin. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto, Ontario.

Cutler-Hammer 9589 Oil Well Pumping Controller with 3 coil overload protection and time delay relay.



Day-omission feature—for non-operation any selected days of week.





Cutler-Hammer Program Time Switch gives automatically scheduled pumping, set up easily by means of pull tabs—one for each 15-minute interval.

Eunice, New Mexico *Carter County, Okla.*

Scurry County, Texas

MEMBER AMERICAN PETROLEUM INSTITUTE

HERE'S TRACTOR-SIDE BOOM CONTROL

that lets you concentrate on the job

Cradling or lowering-in pipe on steep hillsides or mucky swampland demands a crawler operator's full attention—that's why easy-handling Allis-Chalmers tractors and side booms mean so much to a smooth, efficient operation. They provide precise maneuvering with a minimum of effort.

Finger-tip hydraulic booster steering on the HD-15 and HD-20 requires only 3 to 5 lb. pressure on the controls. And to make brake-clutch coordination especially easy, brakes are self-energizing. They require less pedal pressure and take hold with a firm, uniform grip.

Easy-working side boom levers are spaced to give ample hand room. Extendable counterweights operate through finger-tip hydraulic controls. Internal expanding brakes are completely enclosed from dirt and moisture — safe and dependable regardless of weather conditions.

Built-in torque converter drive on the HD-20 eliminates most shifting . . . frees the operator's hands for side boom work. Also, with torque converter drive there's no problem in matching tractor speed to cleaning-priming or doping-wrapping machines — even on steep hillsides. Operator merely advances or retards throttle.

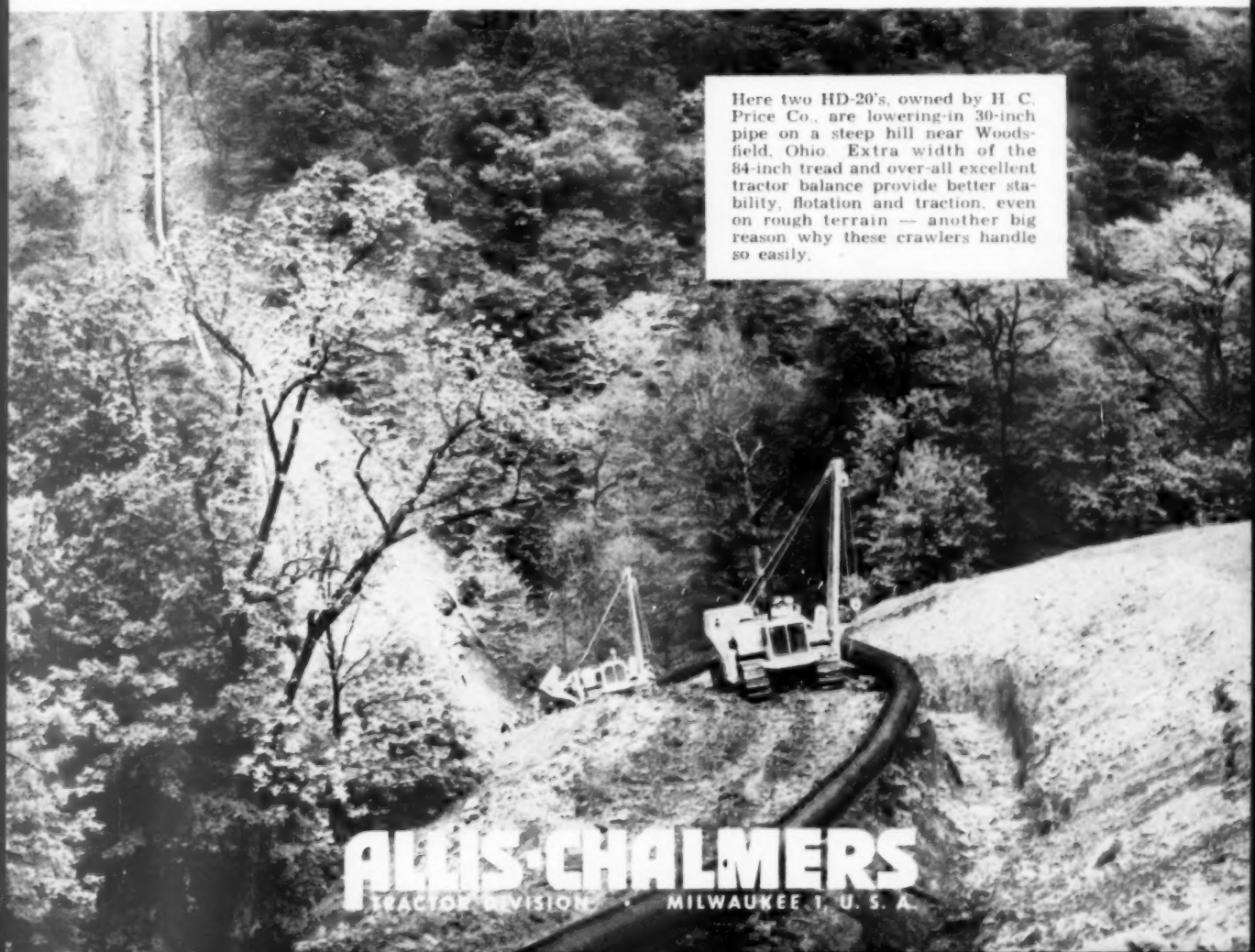
Add to these advantages roomy, adjustable cushion seats, wide arm rests, electric starting and it's easy to see why an operator does more with less effort when he's behind the controls of an Allis-Chalmers tractor. Let your dealer prove it with a demonstration.

HD-15

Boom Tractor with standard counterweights — 50,050 lb.
Bare Tractor — 27,500 lb.
102 drawbar hp.

HD-20

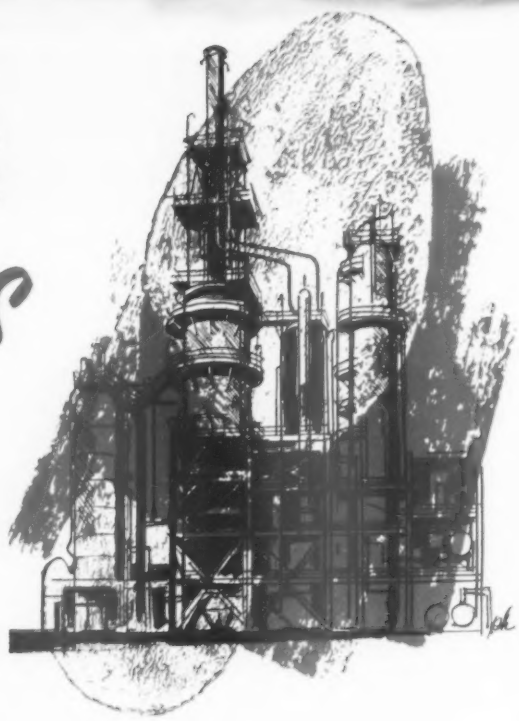
Hydraulic torque converter drive
Boom Tractor with standard counterweights — 71,650 lb.
Bare Tractor — 41,000 lb.
175 net engine hp.

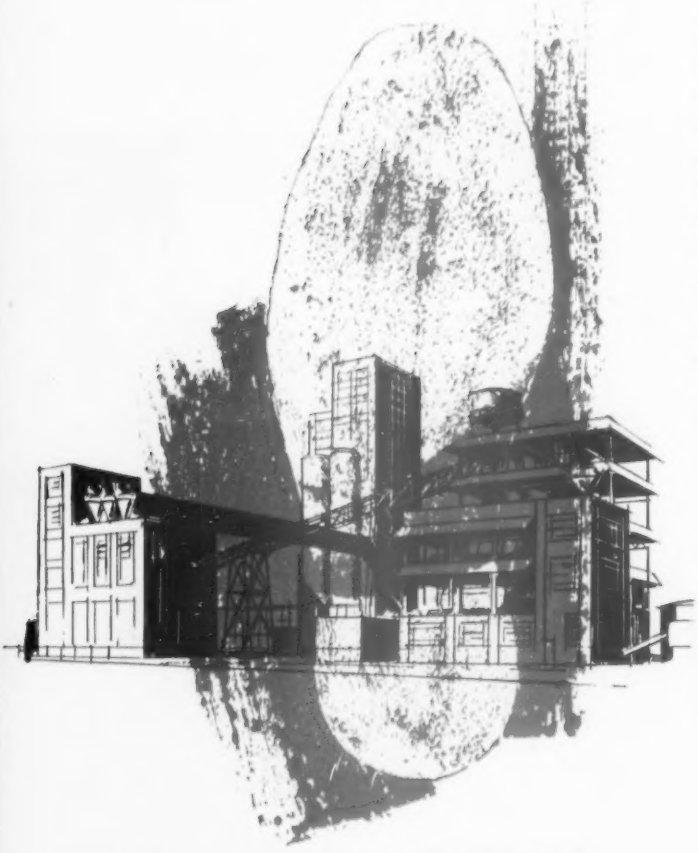


Here two HD-20's, owned by H. C. Price Co., are lowering-in 30-inch pipe on a steep hill near Woodsfield, Ohio. Extra width of the 84-inch tread and over-all excellent tractor balance provide better stability, flotation and traction, even on rough terrain — another big reason why these crawlers handle so easily.

ALLIS-CHALMERS
TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

BLAW-KNOX HAS MADE *GREAT STRIDES* IN BOTH CHEMICAL AND PETROCHEMICAL PROJECT DEVELOPMENT





Time was when Blaw-Knox Company was noted chiefly for its outstanding work in the Chemical and Processing fields. Today, however, Blaw-Knox Chemical Plants Division can look back on the pioneering role it played in the young petrochemical industry! Much of this work was "unorthodox" but not speculative. In every instance, the client came to us with a problem he wanted solved. We engineered an economical solution, and built a successful plant. We welcome the opportunity to put this experience behind any project you may be contemplating.

PLANTS & PROCESSES

Catalytic Reforming • Catalytic Cracking • Decarbonizing • Waste Disposal • Crude Distillation • Ethylene Oxide • Fischer-Tropsch Oxo • Caustic Soda & Chlorine • Extraction • Fractionation • Package Gasoline Stripping • Recycling • Alkylation • Resin Polymerization • Tonnage Oxygen • Synthetic Fuels

Visit the Blaw-Knox booth at the CHEMICAL SHOW, November 30 through December 5, 1953. BOOTH 103.

BLAW-KNOX COMPANY
CHEMICAL PLANTS DIVISION
120 EAST NINTH ST. • TULSA 10, OKLAHOMA
Pittsburgh 30 • Philadelphia 3 • Birmingham 3
New York 17 • Chicago 1 • Washington 5, D.C.
San Francisco 5

BLAW-KNOX

A Great Line of Aluminum to serve you ...2874 different items in stock

Here, stocked for your convenience, is almost every conceivable aluminum item you could want. The quality is here, too! The entire line's produced by ALCOA—the first and foremost aluminum mill in America.

... And you'll find Metal Goods Corporation's 7 warehouses and 11 sales service offices geared to give you swift, efficient service on any of your Alcoa aluminum needs.

Simplify your aluminum procurement problems. Make one call for all your aluminum requirements. Call your nearest Metal Goods Corporation Representative.

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Phone: 5-8721

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Omaha, Nebraska
3515 No. 67th Avenue
C. M. Cooley
Phone: WAlnut 1112

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2600 Woodland
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Phone: 4-9923

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JENKINS PRACTICAL PIPING LAYOUTS

68

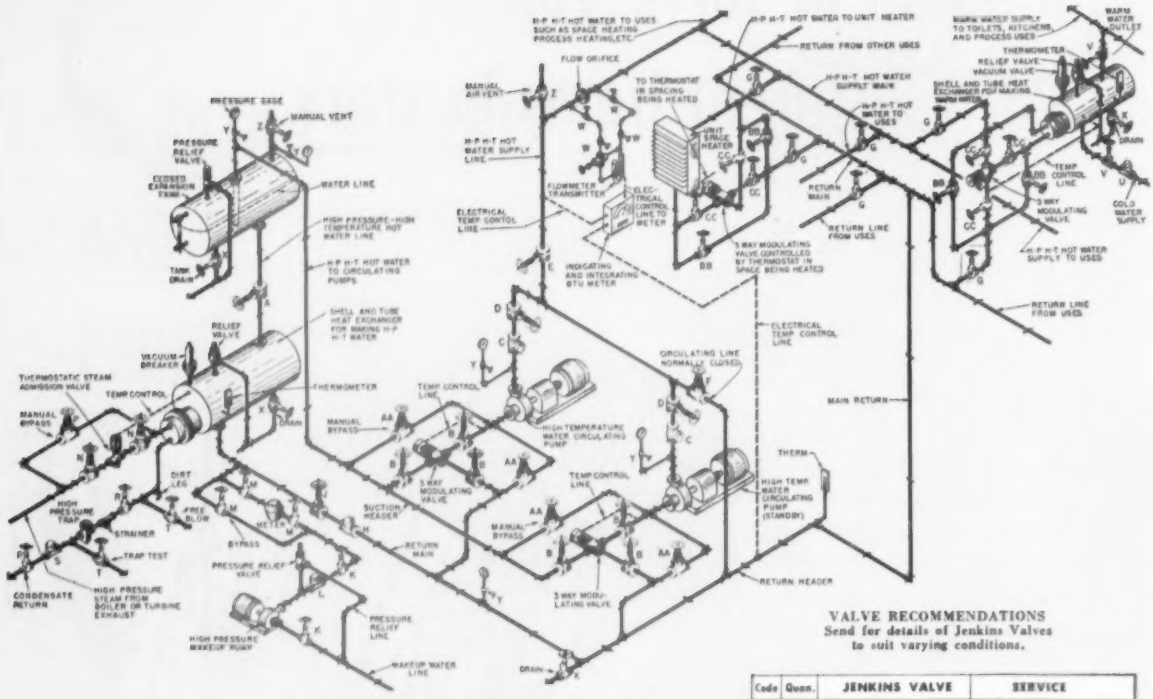
H-P H-T HOT WATER TO USES SUCH AS SPACE HEATING, PROCESS HEATING, ETC.
H-P H-T HOT WATER TO UNIT HEATER
RETURN FROM OTHER USES
WARM WATER SUPPLY TO TOILETS, KITCHENS AND PROCESS USES
WARM WATER OUTLET
THERMOMETER
RELIEF VALVE VACUUM VALVE
SHELL AND TUBE HEAT EXCHANGER FOR MAKING H-P H-T HOT WATER
PRESSURE GAGE
MANUAL VENT
PRESSURE RELIEF VALVE
CLOSED EXPANSION TANK
WATER LINE
HIGH PRESSURE-HIGH TEMPERATURE HOT WATER LINE
H-P H-T HOT WATER TO CIRCULATING PUMPS
TANK DRAIN
SHELL AND TUBE HEAT EXCHANGER FOR MAKING H-P H-T WATER
RELIEF VALVE
VACUUM BREAKER
THERMOSTATIC STEAM ADMISSION VALVE
TEMP CONTROL
THERMOMETER
MANUAL BYPASS
DIRT LEG
HIGH PRESSURE TRAP
FREE BLOW
STRAINER
TRAP TEST
CONDENSATE RETURN
HIGH PRESSURE STEAM FROM BOILER OR TURBINE EXHAUST
BYPASS
PRESSURE RELIEF VALVE
HIGH PRESSURE MAKEUP PUMP
PRESSURE RELIEF LINE
MAKEUP WATER LINE
DRAIN
SUCTION HEADER
RETURN MAIN
MANUAL AIR VENT
H-P H-T HOT WATER SUPPLY LINE
FLOW ORIFICE
TO THERMOSTAT IN SPACING BEING HEATED
FLOWMETER TRANSMITTER
ELECTRICAL TEMP CONTOL LINE
ELEC-TRICAL CONTROL LINE TO METER
INDICATING AND INTEGRATING BTU METER
UNIT SPACE HEATER
3 WAY MODULATING VALVE CONTROLLED BY THERMOSTAT IN SPACE BEING HEATED
RETURN MAIN
H-P H-T HOT WATER SUPPLY MAIN
H-P H-T HOT WATER TO USES
RETURN LINE FROM USES
TEMP CONTROL LINE
3 WAY MODULATING VALVE
COLD WATER SUPPLY
H-P H-T HOT WATER SUPPLY TO USES
RETURN LINE FROM USES
ELECTRICAL TEMP CONTROL LINE
CIRCULATING LINE NORMALLY CLOSED
MAIN RETURN
HIGH TEMPERATURE WATER CIRCULATING PUMP
TEMP CONTROL LINE
3 WAY MODULATING VALVE
HIGH TEMP. WATER CIRCULATING PUMP (STANDBY)
RETURN HEADER

Diagram by Huxley Madeheim, Consulting Engineer
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VALVE RECOMMENDATIONS
Send for details of Jenkins Valves to suit varying conditions.

Code	Quan.	JENKINS VALVE	SERVICE
A	1	Fig. 204 IBBM Gate	HP-HT Hot Water Shutoff
B	6	Fig. 204 IBBM Gate	3 Way Valve Shutoff
C	2	Fig. 339-R IBBM Swing Check	Prevent Backflow
D	2	Fig. 204 IBBM Gate	Pump Discharge Shutoff
E	1	Fig. 204 IBBM Gate	Supply Line Shutoff
F	1	Fig. 923 IBBM Globe	Circulating Line Shutoff
G	6	Fig. 280 Bronze Gate	Branch Shutoffs
H	1	Fig. 339-R IBBM Swing Check	Prevent Backflow
J	1	Fig. 204 IBBM Gate	Return Main Shutoff
K	2	Fig. 280-U Bronze Gate	Makeup Pump Shutoff
L	1	Fig. 962 Bronze Swing Check	Prevent Backflow
M	3	Fig. 280 Bronze Gate	Makeup Meter Shutoff
N	2	Fig. 1010 Cast Steel Gate	Thermostatic Valve Shutoff
P	1	Fig. 1042 Cast Steel Globe	ThermostaticValveBypass
R	2	Fig. 280-UN Bronze Gate	Condensate Line Shutoff
S	1	Fig. 962 Bronze Swing Check	Prevent Condensate Backflow
T	2	Fig. 976-A Bronze Globe	Trap Test, Free Blow
U	1	Fig. 352 Bronze Swing Check	Prevent Backflow
V	2	Fig. 47-U Bronze Gate	Cold Water Shutoff
W	4	Fig. 703 Bronze Globe	Flow Meter Pressure Taps
X	4	Fig. 976-A Bronze Globe	Drain Lines
Y	5	Fig. 703 Bronze Globe	Pressure Gage Control
Z	2	Fig. 976-A Bronze Globe	Air Vents
AA	4	Fig. 923 IBBM Globe	3 Way Valve Bypass
BB	4	Fig. 976-A Bronze Globe	3 Way Valve Bypass
CC	6	Fig. 280 Bronze Gate	3 Way Valve Shutoff

How to plan a HIGH PRESSURE-HIGH TEMPERATURE HOT WATER PIPING SYSTEM

For efficient space and water heating — and for numerous processing needs as well — **a high pressure-high temperature system offers several distinct advantages over a steam system.**

Often operated at pressures up to 215 psi, with a corresponding temperature of 388°F, a HP-HT system of this type eliminates the need for pitch, drainage, or traps and provides a greater amount of heat transmission for a given pipe size. Moreover, it requires no feed-water treatment and, when used for processing services, eliminates large pressure drops due to sudden load conditions.

The hot water is generated in a shell and tube heat exchanger by means of high pressure steam from either turbine extraction or exhaust. Unit heaters on the HP-HT lines provide for space heating requirements and a shell and tube heat exchanger supplies warm water for lavatories, kitchens, and processing which requires moderate temperatures. When used with accumulators, this system eliminates the need for taking additional steam directly from the steam generating source and, thus, provides a better plant heat balance.

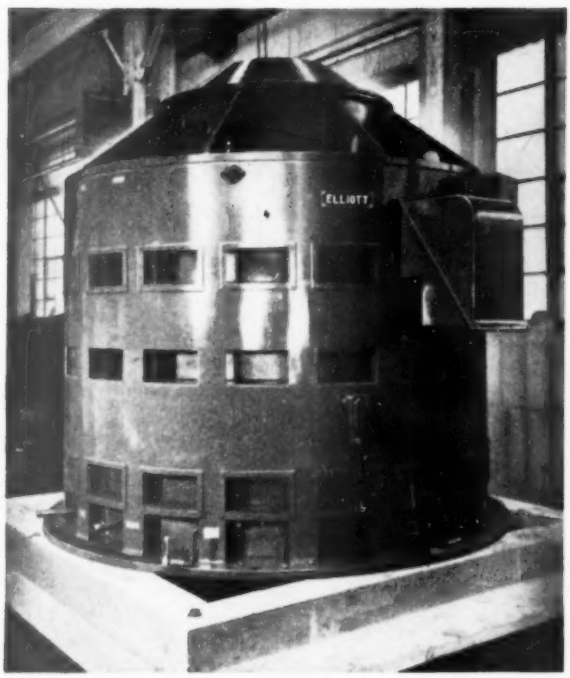
Consultation with accredited piping engineers and contractors is recommended when planning any major piping installation.

To save time, to simplify planning, to get all the advantages of Jenkins specialized valve engineering experience, select all the valves you need from the complete Jenkins line. It's your best assurance of *lowest cost in the long run.* Jenkins Bros., 100 Park Ave., New York 17.

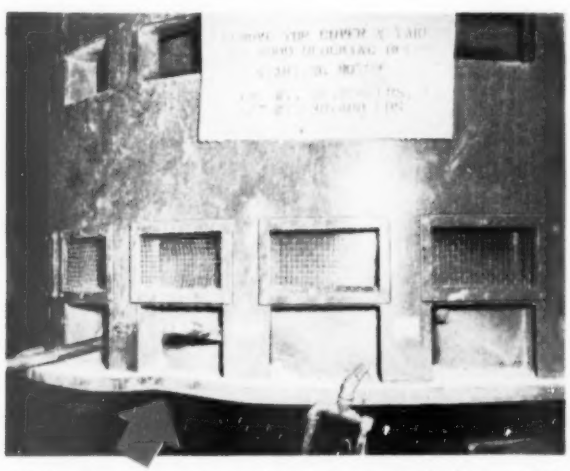
Complete description and enlarged diagram of this layout free on request. Includes additional detailed information. Simply ask for Piping Layout No. 68.

JENKINS
LOOK FOR THE DIAMOND MARK
VALVES
Jenkins Bros

What happened when a 15-ton motor dropped 25 feet!



The motor, good as new, after required repairs and repainting.



The bend in the base ring—the only damage to the frame, which upon disassembly checked absolutely true on the boring mill.

Construction accident conclusively proves the enduring rigidity of ELLIOTT Fabri-Steel motor construction.

It hit with a smack that shook everything for a hundred yards around, when the crane accidentally let go of this big Elliott 2000-hp, 8-pole vertical induction motor while the motor was 25 feet in the air, during installation at a southwestern utility plant. Customer's engineers, witnessing the accident, assumed 100 per cent loss of the motor.

Not so with an Elliott motor with its all-welded steel frame and stator. For here's all that happened to it:

No damage to internal parts of stator or rotor.

Base ring bent between two ribs — easily corrected (see photo).

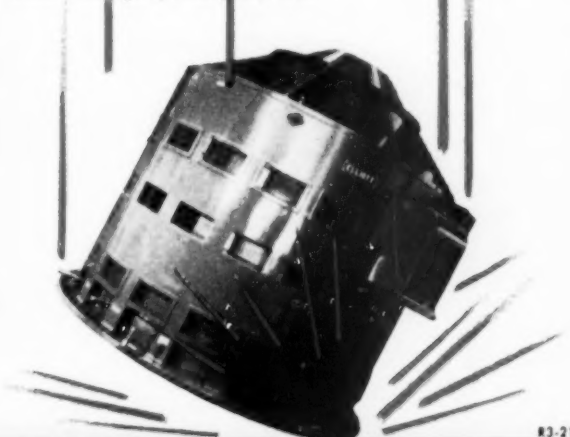
Shaft bent .0034 in. — readily straightened.

Rotor driven up into motor, but stopped by heavy bracket.

Lower oil pot, one baffle, and top cover only needed replacement.

Minor damage to Kingsbury thrust bearing and upper guide shoes. No damage to bottom guide bearing.

And that's all. A demonstration of shock-resistance that would do honor to an army tank. If you want real stiffness in a motor, check on Elliott Fabri-Steel construction — see your local Elliott engineer or write Elliott Company, Ridgway, Pa.

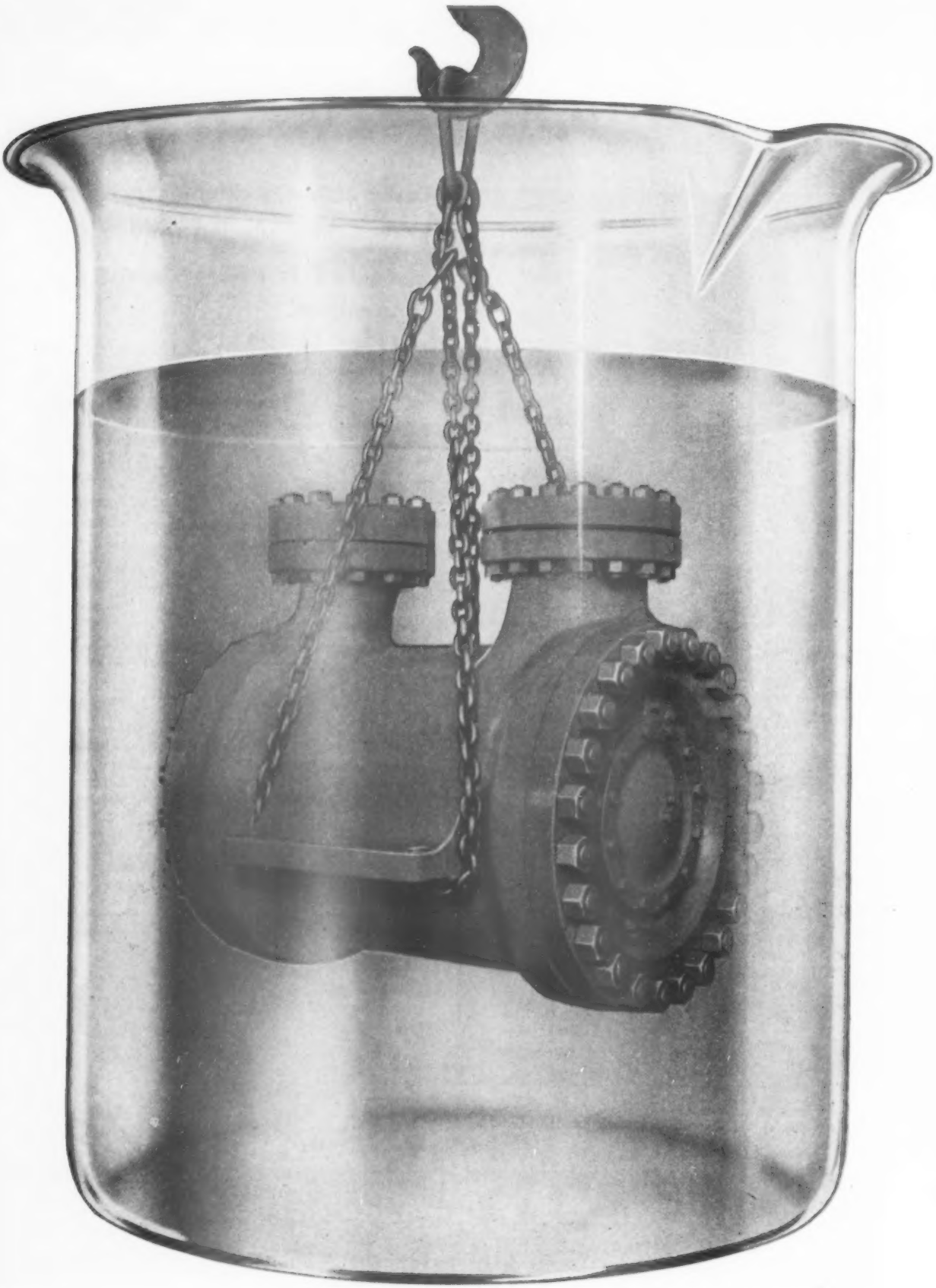


R3-21

Elliott FABRI-STEEL MOTORS AND GENERATORS

ELLIOTT Company RIDGWAY DIVISION

FOR MOTORS 1-200 HP. CROCKER WHEELER DIV. AMPERE, N. J.



"DUNKED"

for your protection

Until a few years ago, if anyone had even *suggested* the use of a centrifugal compressor for over 1000 psi, the idea would have been considered absurd.

Today, pressures of not only 1000 psi, but in excess of *3000 psi,* can be safely handled by the new Clark "Barrel Type" Multi-Stage Centrifugal Compressor.

To assure complete safety to the operators, the cases of these units are hydrostatically tested by Clark at 1½ times maximum working pressure. As a final test, to detect any possible leakage when handling such hazardous gases as hydrogen, the units are pressurized with hydrogen in excess of maximum working pressure while submerged in water . . . *"Dunked" for your protection.*

Already refinery-proved, Clark "Barrel Type" Centrifugals are scheduled to be installed, in the near future, in 7 new catalytic reforming plants which will have a combined capacity of 100,000 barrels per day. They are equally well suited to many other high pressure applications, such as repressuring, ammonia synthesis and wind tunnels.

Your nearest Clark representative will give you complete details.

CLARK BROS. CO. • OLEAN, N. Y.

DIVISION OF DRESSER OPERATIONS, INC.

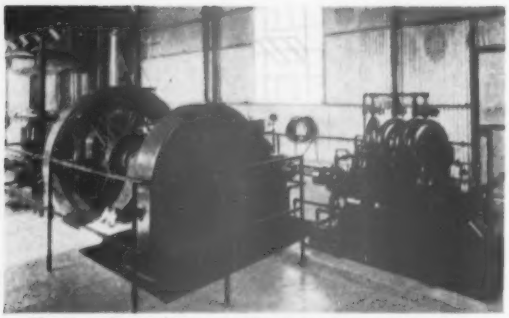
SALES OFFICES IN PRINCIPAL CITIES THROUGHOUT THE WORLD

CLARK compressors

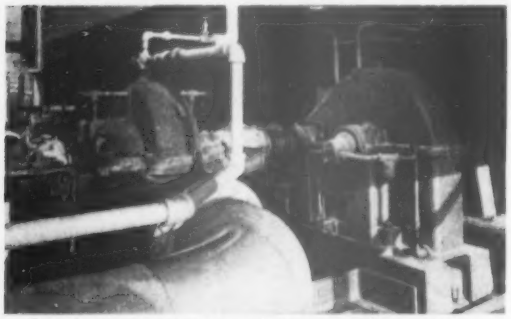
Clark continues to set the pace in compressor progress

© 1953, Clark Bros. Co., Division of Dresser Operations, Inc.

3 FACTS TO REMEMBER!
when you buy speed increasers



This Farrel speed increaser has been in operation since 1932. It transmits 250 HP from a gas engine to a centrifugal pump.



Farrel speed increasing unit in an outdoor installation at a gasoline absorption plant.

This Farrel two-pinion speed increaser delivers 300 HP to each of two pumps from a single 600 HP engine.

1 PERFORMANCE RECORD

For many years, Farrel® has worked closely with the oil industry in designing speed increasers to provide continuous, trouble-free operation with a minimum of down-time for maintenance and adjustment. How successful this program has been is shown by the record. Of the hundreds and hundreds of units installed in pipeline pumping stations since 1932, *all* are still operating successfully.

2 FOR ANY SERVICE CONDITIONS

Farrel engineering can solve your special service problem. For example, units for outdoor service have been developed for successful operation under the most adverse conditions — continuous heavy-duty operation, dust, rain, sandstorms, severe heat and intense cold.

3 TO YOUR REQUIREMENTS

Farrel speed increasers are available in a standard line with ratios ranging from 1:1 to 12:1. For higher ratios, double step-up units are supplied with ratio range from 12:1 to 40:1. Two pinion units, designed to transmit power from a single engine to two pumps, are also available. These can be furnished with any gear ratio required.

FARREL-BIRMINGHAM COMPANY, INC., ANSONIA, CONN.

Plants: Ansonia and Derby, Conn., Buffalo, N. Y.

Sales Offices: Ansonia, Buffalo, New York, Boston, Akron, Detroit, Chicago, Memphis, Minneapolis, Portland (Oregon), Los Angeles, Salt Lake City, New Orleans

OIL FIELD REPRESENTATIVES

Hercules-Lupfer Engine Sales Co., 124 N. Boston St., Tulsa 1, Oklahoma.
V. W. Osborne, 860-A M & M Building, Houston 2, Texas

Farrel-Birmingham®

FB-858

SIMPLE and EASY TO USE

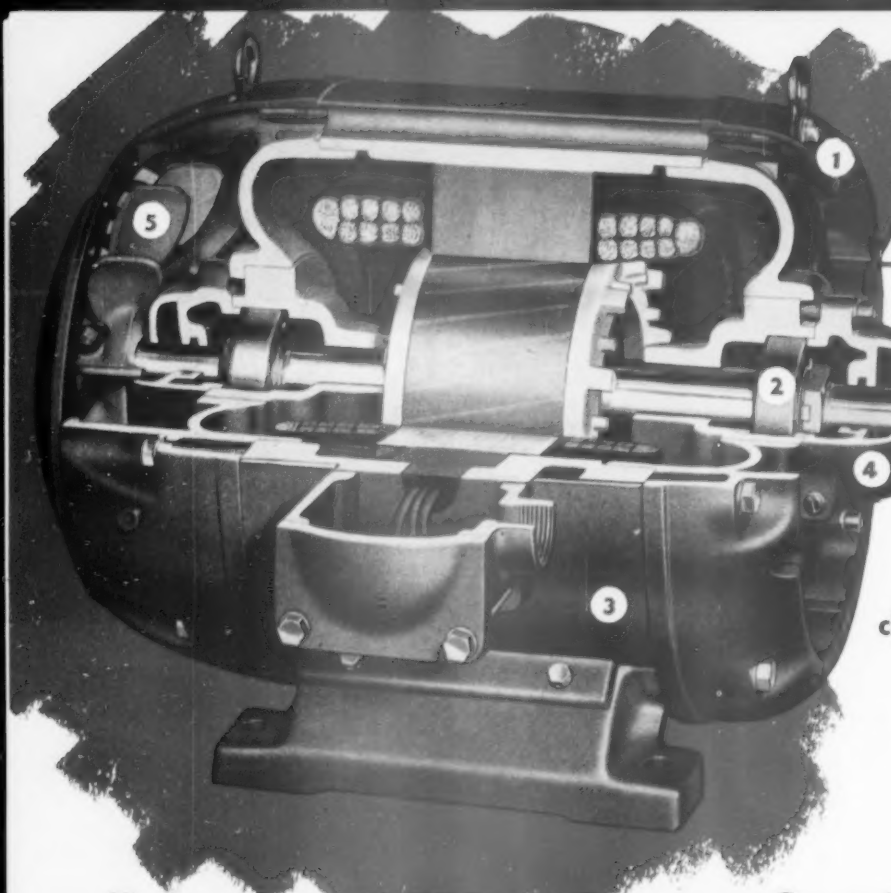
Midwest Reducing Elbow replaces two fittings: (1) a straight size elbow and (2) a reducer. One weld is eliminated with a resultant saving in layout time, welding, and cost. Pressure drop is reduced, appearance is improved and the piping is easier to insulate. Sizes to 12", reductions to half size.

Children get the hang of a bubble pipe almost by instinct . . . it's so simple and easy to use. Pipe welders report that they find Midwest Welding Fittings simple and easy to use because they are so uniform . . . so accurate to dimension . . . and because of their greater variety. Representative of this greater variety is the Midwest Reducing Elbow (shown at right) which takes the place of a standard elbow and a reducer . . . requires only two welds instead of three. For more information on why Midwest Welding Fittings are simple and easy to use, ask for Catalog 48.

MIDWEST PIPING COMPANY, INC.
Main Office: 1450 South Second Street, St. Louis 4, Mo.
Plants: St. Louis, Passaic, Los Angeles and Boston
Sales Offices:
New York 7—50 Church St. • Chicago 3—79 West Monroe St.
Los Angeles 33—520 Anderson St. • Houston 2—1213 Capitol Ave.
Tulsa 3—224 Wright Bldg. • Boston 27—426 First St.
STOCKING DISTRIBUTORS IN PRINCIPAL CITIES

MIDWEST WELDING FITTINGS

MIDWEST
WELDING FITTINGS
Improve Piping Design and Reduce Costs



5-way Protection

— protection against volatile vapors . . . chemical fumes, corrosive liquids . . . high humidity . . . salt air

Louis Allis Chemical Motors

A Louis Allis Chemical Motor protects you these five ways against corrosion:

1. Cast-iron construction. Stator housing, end brackets, and conduit box are cast iron, well-known for its resistance to corrosion.

2. Cartridge-type ball bearings. Motor can be completely disassembled without exposing bearings or lubricating grease to dust.

3. Stainless-steel shell over housing. Non-corrosive shell directs air over housing to cool motor. Shell is easily removed, to clean air passages.

4. Removable bearing caps. Let you examine bearings without dismantling motor.

5. Cast-bronze ventilating fan. Keeps motor temperature down, and is non-corrosive.

Additional features available include: Special Class A or Class B chemical insulation for extreme corrosive conditions or high ambient temperatures; and drain and breather plugs for elimination of internal condensation due to "breathing."

You can get Louis Allis Chemical Motors in NEMA frames 224 through 505 and frame 108 — in standard, enclosed, fan-cooled construction and enclosed, fan-cooled, explosion-proof construction. They carry Underwriters' approval for Class I, Group D or Class II, Group F or G hazardous locations.

Let the Louis Allis engineer help you solve *your* motor problem and cut your maintenance costs. Call him in soon.

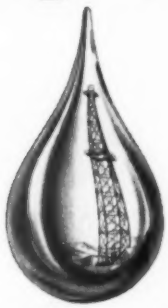
THE LOUIS ALLIS CO., *Milwaukee 7, Wisconsin*

CM-101

We specialize in SPECIAL MOTORS

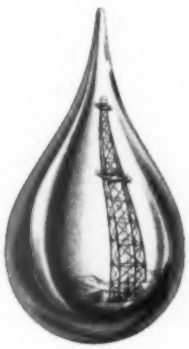
Standard or special — we build it. Whatever electrical or mechanical modifications or features you need, there is a Louis Allis motor that will do your toughest jobs better.

buying caustic soda



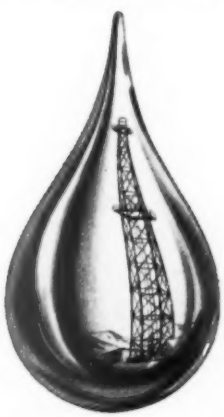
A petroleum refinery expanding production in the Southwest needed a firm source of supply of caustic soda. Requirements ran to several cars a day and, due to limited storage facilities, close scheduling of shipments was essential.

to better advantage



Like many other petroleum refineries in this area, this plant could be best supplied by Mathieson from production at Lake Charles, Louisiana. Also, only Mathieson could provide the added protection of caustic plants at McIntosh, Huntsville and Anniston, Alabama, and Saltville, Virginia—all within reasonable shipping distance. Mathieson, in addition, is a dependable source of many chemicals essential to refining . . . sulphuric acid, soda ash, ammonia, sulphur, carbonic gas, chlorine, sodium nitrate and sodium chlorite. Moreover, Mathieson often provides an outlet for waste products from the refining process.

from Mathieson



These same advantages will be of benefit to you. You'll be sure of top-quality chemicals . . . multi-plant production facilities provide dependability . . . integrated delivery system assures on-time schedules. You'll find you can buy chemicals to better advantage—at any time—by consulting with Mathieson.

caustic soda • soda ash • liquid chlorine • sulphur • sulphuric acid • bicarbonate of soda • ammonia • sodium nitrate • nitric acid • hydrazine • sodium methylate • sodium chlorite • hypochlorite products • dry ice and carbonic gas • ammonium sulphate • ethylene derivatives • methanol

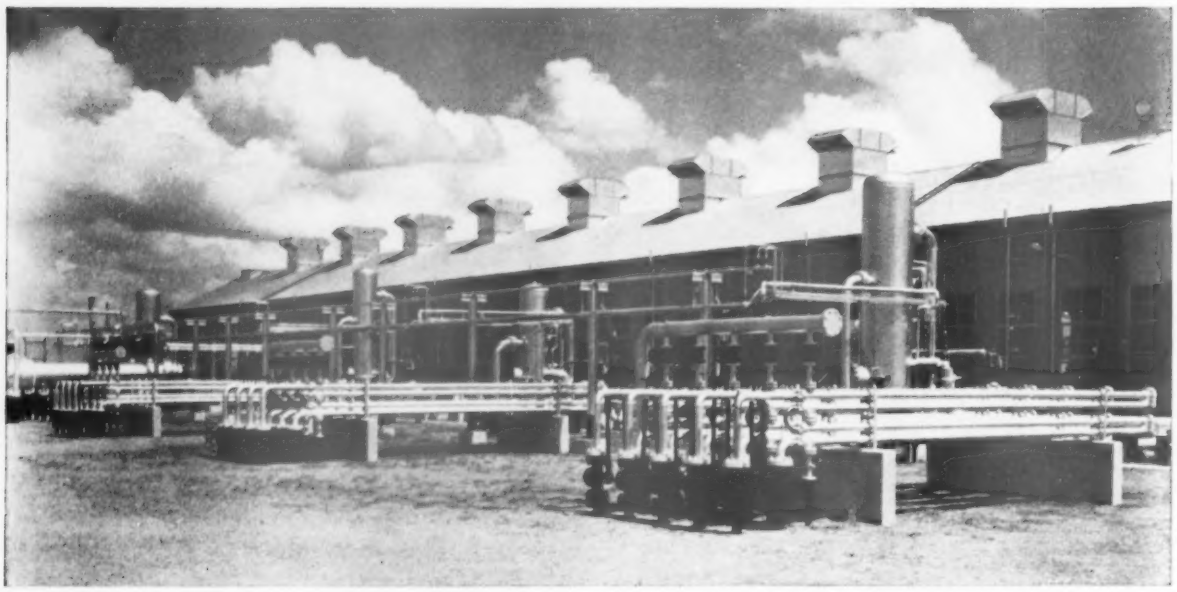
MATHIESON

MATHIESON CHEMICAL CORPORATION
Mathieson Industrial Chemicals Division
Baltimore 3, Maryland

1616

Assure Top Efficiency

in your plant with



BROWN FINTUBE *Sectional* HEAT EXCHANGERS

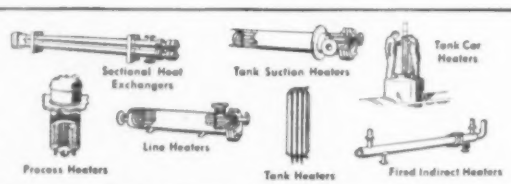
● Avoid the loss in efficiency that results from just a few thousandths of an inch of deposit on the tubes, by using Brown Fintube Sectional Exchangers for every heating and cooling service.

The longitudinal passages of Brown Fintube Sections control the material flow, eliminating baffles and the back eddies that encourage fouling. Their greater heating surface — 2 to 8 times that of bare tubes — permits more BTUs to be transferred at lower temperature per square foot of surface, minimizing "coking" and charring. Brown Fintube Sections are easy to clean — and — by simply manifolding a few extra sections into the unit, one stream after another can be taken off line for cleaning while the rest — always thoroughly clean — carry the unit's full rated capacity, year after year — without any shut-downs.

Efficient heating, is only one of Brown Fintube's many advantages. You'll find full details in our Bulletin No. 512. It will give you ideas.

BROWN FINTUBE
HEAT TRANSFER PRODUCTS

BROWN FINTUBE CO.
Elyria, Ohio

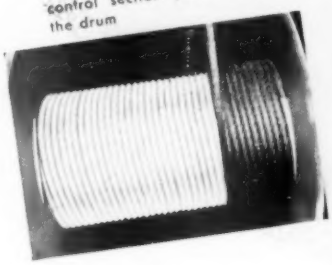


NEW YORK • BOSTON • PHILADELPHIA • PITTSBURGH • BUFFALO • CLEVELAND • CINCINNATI • DETROIT • CHICAGO • ST. PAUL • ST. LOUIS • KANSAS CITY
MEMPHIS • BIRMINGHAM • NEW ORLEANS • SHREVEPORT • TULSA • HOUSTON • DALLAS • DENVER • LOS ANGELES • SAN FRANCISCO • and ST. THOMAS, ONT.

PAGES FROM THE LEBUS WIRE LINE SPOOLING HANDBOOK

ENGINES RUN SMOOTHLY . . . BUT WHAT ABOUT WIRE LINE?

These two photos illustrate good spooling with LeBus Grooving. The top photo shows the second and third layer of line spooling evenly on the drum. The lower photo shows that less line is used when picking up the load and shows the Angle control section (20% to 25%) of the drum.



No matter how you look at it, the engines on a drilling rig must run smooth and be producing the top in horsepower and efficiency . . . Also . . . it is a known fact that to receive full value from your wire line it must be spooled correctly in order to run smoothly. A bad spooling job on a drilling rig drum causes wire line cutting-in, pinching and squeezing, plus wire line whip from drum to crown block, all of which decreases the efficiency of your engines as well as your wire line.

Today, over 1,600 drilling rig drums are grooved with LeBus Grooving and Controlled Pyramid Spooling. Contractors who have installed LeBus Grooving will tell you it is the finest investment they have ever made, because LeBus Grooving SAVES TIME, MONEY, and WIRE LINE.

Write today for full details.

LEBUS INTERNATIONAL ENGINEERS LIMITED

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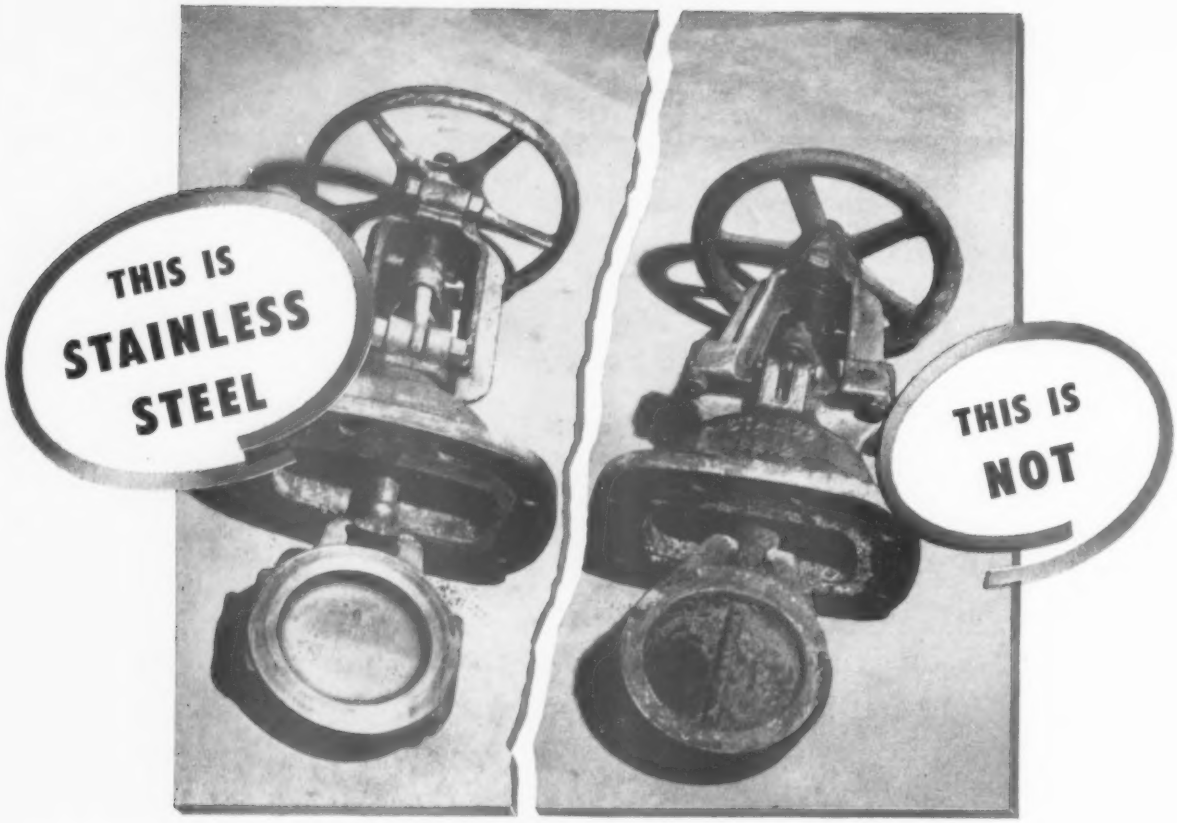

—yet the Stainless valve is twice as old!

ANOTHER GROUP of Stainless Steel valves used in the operation of this Gulf Coast Refinery.

HERE'S photographic evidence of the way Stainless Steel's superior corrosion resistance keeps it in service under severe conditions far longer than other materials.

Both of these end gate valves were in service in one of the pipe stills at a Gulf Coast Refinery. The valve at the left, trimmed with Stainless Steel, is still in excellent condition after two years of service in light Crude Naphtha containing sulfur compounds. But the other valve, made of less durable materials, failed after a year of the same kind of service.

Stainless Steel's ability to stand up under severe service pays off in fewer costly shutdowns, less maintenance and longer equipment life. In many applications, it is far and away the most economical material you can use.

For finest performance, make sure the Stainless you use is perfected, service-tested U·S·S Stainless Steel.

UNITED STATES STEEL CORPORATION, PITTSBURGH · AMERICAN STEEL & WIRE DIVISION, CLEVELAND
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO · NATIONAL TUBE DIVISION, PITTSBURGH
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. · UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
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U·S·S STAINLESS STEEL

USS

SHEETS · STRIP · PLATES · BARS · BILLETS
PIPE · TUBES · WIRE · SPECIAL SECTIONS

3-873

UNITED STATES STEEL

Want on-the-spot fire protection?

Tower 50 feet high holds antenna which covers 16 miles of yard trackage—reaches vehicles up to 33 miles away. Any structure can serve as an antenna base

Regular vehicles equipped with RCA 2-Way Radio serve as an effective fire and emergency patrol—have instant, positive communications with the dispatcher's office

Get it FAST with RCA 2-Way Radio!

. . . Vehicles at Socony-Vacuum Refinery, Paulsboro, N. J. double-up as roving patrol

Small transmitter in dispatcher's office keeps him in direct contact with 13 vehicles

"In cases of emergency one of our roving vehicles can get in immediate contact with the dispatcher's office by radio." That's how the automobile foreman of this 900-acre refinery uses RCA 2-Way Radio to cope with emergencies that arise.

"Thirteen vehicles are equipped with RCA 2-Way Radio," he reports. "Each becomes a roving patrol station to call for assistance or give information from any spot on the refinery site. And coverage is complete. *There are no dead spots.*"

RCA 2-Way Radio offers you instant, direct communication with all your vehicles—*indoors or out*. An efficient materials handling device . . . it doubles as an effective fire protection aid, saves expensive man- and equipment hours.

RCA 2-Way Radio units are compact, tough, reliable . . . as easy to use as a telephone . . . and readily installed and serviced by the nation-wide RCA Service Company. *Mail Coupon below for free booklet* which tells you the full story of RCA 2-Way Radio.

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CAMDEN, N.J.

Radio Corporation of America, Communications Equipment
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☐ Please send me information on RCA 2-Way Radio.
☐ Please have a representative get in touch with me.

NAME_____ TITLE_____

COMPANY_____

ADDRESS_____

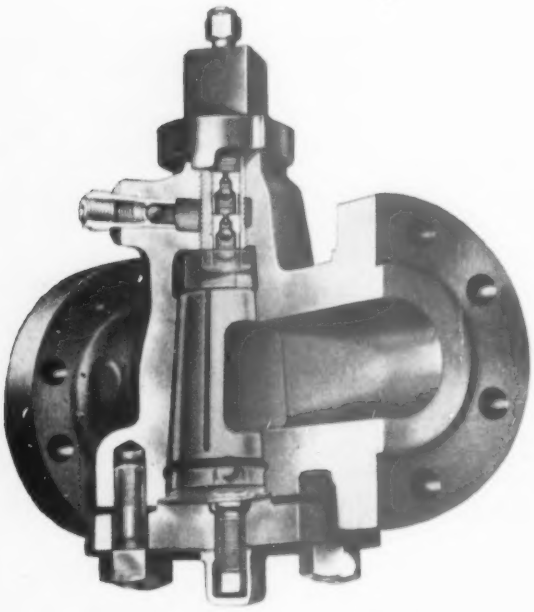
CITY_____ ZONE ____ STATE_____

What is the advantage of a lubricated valve?

Sometimes the purpose of lubricant in a valve is misunderstood.

The most important function of lubricant in a Nordstrom valve is to give a *tighter seal* than can be accomplished through any other method yet developed. The thin film of plastic lubricant that is forced around the ports of the plug is a *pressure seal* in itself.

Of course, the lubricant has other obvious advantages . . . the same advantages it has in your automobile, or in any other mechanical equipment where metal rubs metal. The lubricant all but eliminates the possibility of galling or seizing, and consequently keeps the valve ready to operate in a hurry. A lubricated Nordstrom valve operates easily even against high line pressures, because the plug turns *within* the line, rather than being forced or wedged *against* it. Since it takes only a quarter turn of the plug to open or close the valve, it operates in seconds instead of minutes.



Cutaway view of Nordstrom Hypreseal valve

HOW A NORDSTROM VALVE WORKS

In a Nordstrom valve, lubricant is forced through a series of grooves surrounding the plug ports. There it acts as an extra seal against the little leaks that become big problems. It is also forced into a lubricant chamber at the small end of the plug where it serves as a hydraulic jack to keep the plug easy to turn. Finally, it *lubricates* . . . that is, it prevents grinding wear, fills tiny imperfections that may develop, and it lets the plug slide without grating.

Don't be misled . . .

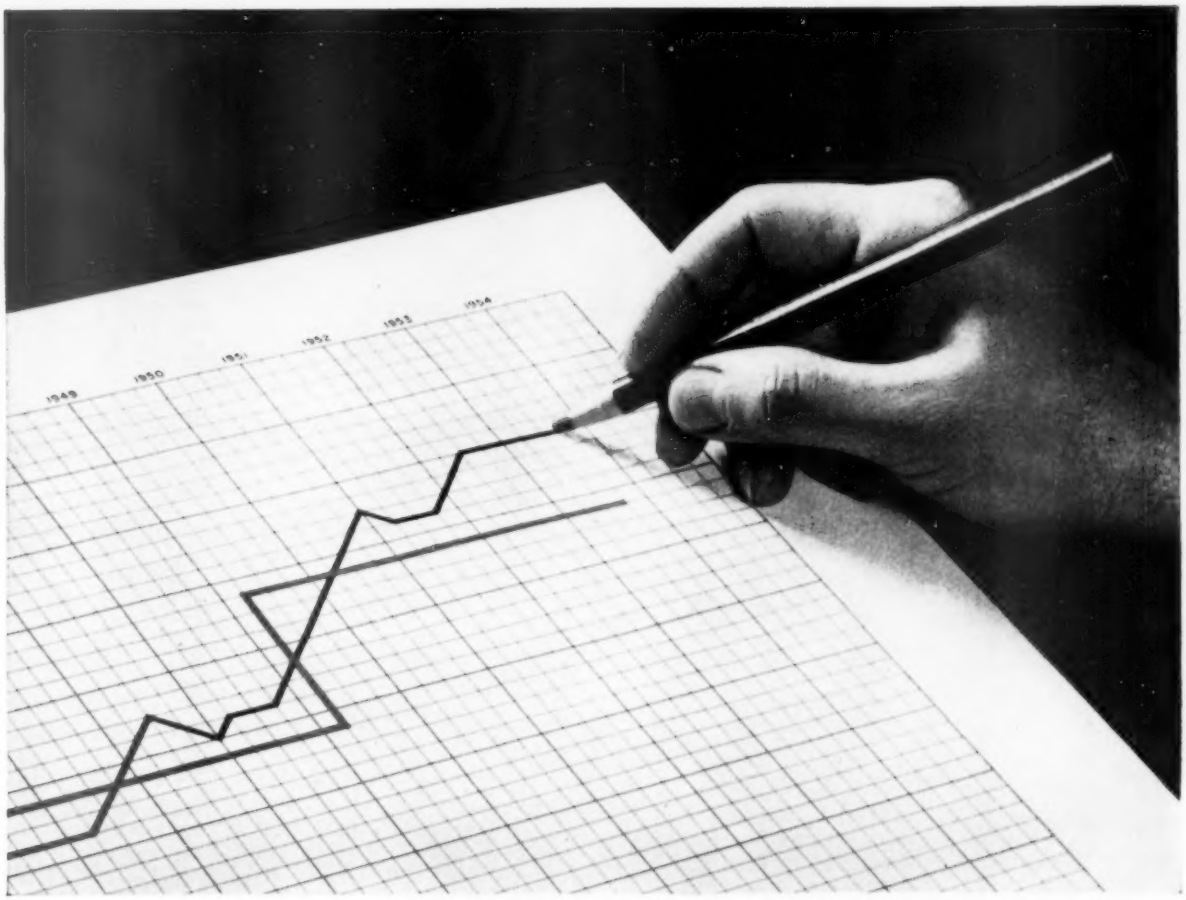
Valve lubrication doesn't *cost* money, it *saves* money. Your Nordstrom representative will help you select the right Nordstrom valves for your application. Rockwell Manufacturing Company, Pittsburgh 8, Pa.

ROCKWELL Built

Nordstrom Valves

Lubricant-Sealed for Positive Shut-Off

Another Rockwell Product



Caution: dangerous curves

Keeping your fire protection properly balanced with changes in processes as well as ups and downs in production is vital to efficient, profitable operation.

You'll find your best answer to this serious fire problem which is currently confronting industry by installing an expansible, fully approved C-O-TWO Low Pressure Carbon Dioxide Type Fire Extinguishing System. Simple piping, running from one centrally located storage tank, instantly transports clean, non-damaging, non-conducting carbon dioxide anywhere in the plant area. Fire at any protected location is extinguished in seconds with an absolute minimum of expense and interruption.

Changes in your fire protection requirements are easily and economically provided for with a C-O-TWO Low Pressure Carbon Dioxide Type Fire Extinguishing System by initially installing an oversized storage tank and adding where necessary the supplementary discharge facilities at a later date.

Flexibility is the keynote . . . the low pressure carbon dioxide storage tanks range in capacity from one to fifty tons . . . discharge facilities can be either manual mechanical, manual electric, automatic mechanical, automatic electric or a combination of these . . . especially installed to fit your particular needs.

WHEN BUSINESS STOPS . . . INCOME STOPS!

Don't take chances with your investment. Secure the benefits of highly efficient fire protection engineering today . . . our extensive experience over the years is at your disposal without obligation. Get the facts now!

C-O-TWO

MANUFACTURERS OF APPROVED FIRE PROTECTION EQUIPMENT

Squeez-Grip Carbon Dioxide Type Fire Extinguishers
Dry Chemical Type Fire Extinguishers
Built-In High Pressure and Low Pressure Carbon Dioxide Type Fire Extinguishing Systems
Built-In Smoke and Heat Fire Detecting Systems

C-O-TWO FIRE EQUIPMENT COMPANY
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C-O-TWO FIRE EQUIPMENT OF CANADA, LTD. • TORONTO 8 • ONTARIO

Sales and Service in the Principal Cities of United States and Canada

AFFILIATED WITH PYRENE MANUFACTURING COMPANY

If Henry Hudson could see it now...

DELAWARE U·S·A VALLEY

To Henry Hudson who first explored it, the Delaware River was a possible passage to the wealth of the Indies. Little could he have foreseen that on the banks of this great river there would one day arise an industrial empire that would surpass even his wildest dreams of Eastern riches.

Delaware Valley, U.S.A. it has come to be known —America's fastest growing industrial area—a cross section of both the nation's industry and many of its best known names.

CF&I is proud that its steel and steel products mill at Claymont, Delaware is located in the Delaware Valley. Our future plans for expansion of production facilities will contribute still further to the development of this "valley of opportunity."

1971

CLAYMONT STEEL

WICKWIRE SPENCER STEEL DIVISION
THE COLORADO FUEL AND IRON CORPORATION
CLAYMONT, DELAWARE

CF&I

DU PONT

PETROLEUM CHEMICALS DIVISION NEWS

DU PONT

November ★ One of a Series of Interest to the Petroleum Industry ★ 1953

When the customer says

"WHY CHANGE OIL?"

This new Du Pont folder will help your dealers to have a ready answer

The need for oil change at regular intervals has been frequently attacked in the public press. As a result, many motorists resist the service station operators' efforts to protect their cars with regular oil changes.

To help your dealers cope with this situation, Du Pont has prepared a small folder on the main reasons for changing crankcase oil. The copy is short, snappy, and easy to remember. Each point is clearly illustrated by a cartoon drawing.

For sample copies and information on how to obtain the folders for your dealers, write to any Du Pont Petroleum Chemicals Division district office. The title is "When the customer says *'Why Change Oil?'*"

How much do price and credit influence gasoline buying?

Du Pont's 4th survey report on consumer gasoline buying habits indicates motorists are not as price conscious as previously believed

Do "price wars" have any justification? Are credit cards business getters? Do local charge accounts build station or dealer loyalty?

Some of your customers have told us their answers to these important questions. And what they say may have a vital bearing on your future marketing plans. To help marketers solve the riddle of the dollar sign, the Du Pont Petroleum Chemicals Division is now distributing Report No. 4 of its nationwide survey of consumer gasoline buying habits.

THE INFLUENCE OF PRICE, credit cards and charge accounts on gasoline purchasing patterns is analyzed in the 4th report in Du Pont's continuing series.

Cartoon Storyboard for Showing Survey Data at Dealer Meetings

Buying habit statistics are an important ingredient in any sound marketing program. But at a dealer meeting, plain statistics are likely to cause an epidemic of sleeping sickness.

To help you present — graphically and entertainingly — the basic marketing information in the Du Pont Buying Habit Survey, we will be glad to prepare for you a rough cartoon-style storyboard. This can be easily made into an entertaining sound slide film.

The storyboard weaves the factual survey data into a cartoon-style chain of events involving the relationship between dealer and customer. Key facts are put in terms of the dealer's own yardstick of personal experience. And the script is tailored to fit your own brand and individual marketing problems.

Several oil companies are already using sound slide films made from Du Pont-prepared storyboards. They are highly enthusiastic about the results obtained.

The average motorist, the survey found, is well informed on gasoline prices and the price difference between grades. In fact, three out of four said the price they paid for gasoline was generally the same as for competing brands. (And prices reported in the survey agreed with posted prices in the areas studied.)

"PRICE WARS"

It may surprise some marketing executives to learn that few of the motorists interviewed even recall "price wars." And still fewer switched brands or stations to take advantage of such drastically reduced prices.

And price is no deterrent in the sale

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

DU PONT

PETROLEUM CHEMICALS DIVISION
NEWS

DU PONT

CONTINUED *Price and Credit*

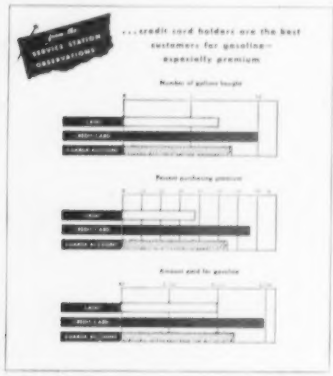
of the better grade of gasoline. Moreover, the frequency of premium purchase is greatest in areas where higher premium prices prevail.

CREDIT CARDS

The survey shows that 12% of the motorists in the U. S. hold oil company credit cards. But the percentage varies widely in different geographic areas. In the West, for example, nearly 30% hold credit cards. Service station observations show that the possession of a credit card practically assures that it will be used—and used regularly.

Good credit generally denotes a good customer. And this holds true in gasoline marketing as well as in any other business.

Credit cards are used most extensively by the upper income groups, and more than half the credit card holders say they use the card for services and products other than gasoline. Credit card holders are, therefore, in most cases, "best" customers.



THESE CHARTS from Report No. 4 of "The Service Station and the Motorist," based on actual service station observations, show that credit card holders are the "best" gasoline customers.

CHARGE ACCOUNTS

Almost 27% of the motorists interviewed said they have a charge account at a local service station. Point-of-purchase observations show that 14% of gasoline purchases are by charge account.

In contrast to credit cards, charge accounts are largely a personal arrangement between an individual dealer and his customers. And, independent of brand loyalty, a dealer's personal friendship with his customers generally determines the amount of his charge account business.

QUALITY FACTOR

Only about 10% of the total gasoline market are "price buyers." However, the number of motorists who buy premium because they associate high price with high quality is almost as great.

National in scope, the Du Pont survey is based on 3,100 household interviews and 21,000 observations at 1,193 service stations. The previous three reports covered service station selection and loyalty, brand name recognition and loyalty, and gasoline grade preferences. Future reports will deal with oil and TBA purchases and dealer services.

The information made available to the oil industry through this survey, we believe, will be extremely useful in planning merchandising and promotion programs.

Eastern District Assistant Manager

BARRY V. CORNWALL

BARRY V. CORNWALL, now assistant manager for the Eastern district, joined the Petroleum Chemicals Division in 1952 as technical assistant to the director of sales.

He has been associated with the Du Pont Company since 1929. His first assignment was as a technician in the service laboratory of the Dyestuffs Division. He later became a salesman for anti-freeze and industrial solvents in the Alcohol Division.

Prior to his transfer to the Petroleum Chemicals Division, Mr. Cornwall was assistant sales manager of the Alcohol and Camphor Section.

Born in Winnipeg, Canada, he graduated from Clemson College. During World War II, he served four years in the U. S. Army.

Storage Tests Recommended For Fuel Oil Additive No. 2

If you have been trying to determine the effectiveness of Fuel Oil Additive No. 2 in your own stocks by an accelerated method, you may have been discouraged by the results.

For a true indication of the effectiveness of Du Pont Fuel Oil Additive No. 2, you cannot depend entirely on accelerated tests. *Storage* tests at temperatures approximating field conditions should be used whenever possible.

However, if actual storage tests take too long to be practical for your purposes, storage tests at a temperature of 110°F. is a good compromise. This accelerates aging enough to give comparisons in a few weeks. But the temperature isn't high enough to invalidate test results.

Samples of Fuel Oil Additive No. 2 for testing are available from any Du Pont Petroleum Chemicals Division district office.

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. . . *through Chemistry*

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A-6203

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P-A VENTURI GAS SCRUBBERS

Here's why ONE INSTALLATION leads to another

Repeat business is a sure sign of client satisfaction in any field. That's why the record of repeat installations of Chemico P-A Venturi Scrubbers is impressive. Most Chemico installations currently underway have predecessors in the same company or in the same scrubbing field.

Multiple installations are presently in service scrubbing sulfuric and phosphoric acid mists, metallurgical dusts and many other of the *more difficult* fumes encountered in the chemical industry.

If you have a serious air pollution or waste recovery problem not in our experience file, we will be glad to send one of our experienced engineers to make reliable pilot tests at your plant with our portable equipment.

1. *Low capital cost*

WHY are capital costs low?
Because of simplicity of design.

2. *Low maintenance expense*

WHY are maintenance costs low?
Because there are no complex accessories required to maintain units at top performance levels.

3. *High collection efficiency*

WHY are collection efficiencies so high?
Because the patented feature of the P-A Venturi induces a high degree of particle agglomeration.

Phone (MU 8-2370) or write our P-A Sales Dept. for further information and ask for our Bulletin M-102 on P-A Gas Scrubbers.

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☆ ANNOUNCING NEW ☆

DODGE "Job-Rated" TRUCKS

Brilliant new design opens new era in trucking!

☆ **Compare their new comfort!** ☆ **Test their new handling ease!**
☆ **See their new low work-saving design!**

2 GREAT ENGINE LINE-UPS! In addition to cost-cutting 6's, Dodge now offers the most powerful V-8 engines of all leading trucks! Available in 1½-, 2-, and 2½-ton models . . . standard in 2¾-, 3-, 3½-ton! Revolutionary hemispherical combustion chamber for high efficiency! Get free book on engine efficiency and its importance to you at your Dodge dealer's!

OVER 75 NEW FEATURES! Spectacular low-built lines! New increases in G.C.W.! New cab sealing against dust, drafts! Nonskid running boards!

PLUS famous Dodge features like . . . completely rustproofed sheet metal . . . moistureproof ignition! Truck-o-matic transmission with gýrol Fluid Drive, available!

New! Even greater values . . . yet still priced with the lowest!

New! Sharper Turning! New steering system for the shortest turning of all leading trucks! New shorter conventional tractors! New, one-piece windshield! More total vision area than any other popular make!

New! Smarter Styling! New colors! New flow-line design, featuring integral fenders, sparkling chrome! New two-tone interior styling! New wider doors! New easy-chair seats! New instrument panel.

New! Lower Lines! Pick-up and panel floors knee-high for loading ease! Lower running board for easier entry! Lower hood for greater visibility! New, low center of gravity for road-hugging stability!

SEE YOUR FRIENDLY DODGE DEALER!

THE COST OF A LUNKENHEIMER VALVE GETS SMALLER AND SMALLER AND SMALLER

with each passing year
of DEPENDABLE SERVICE

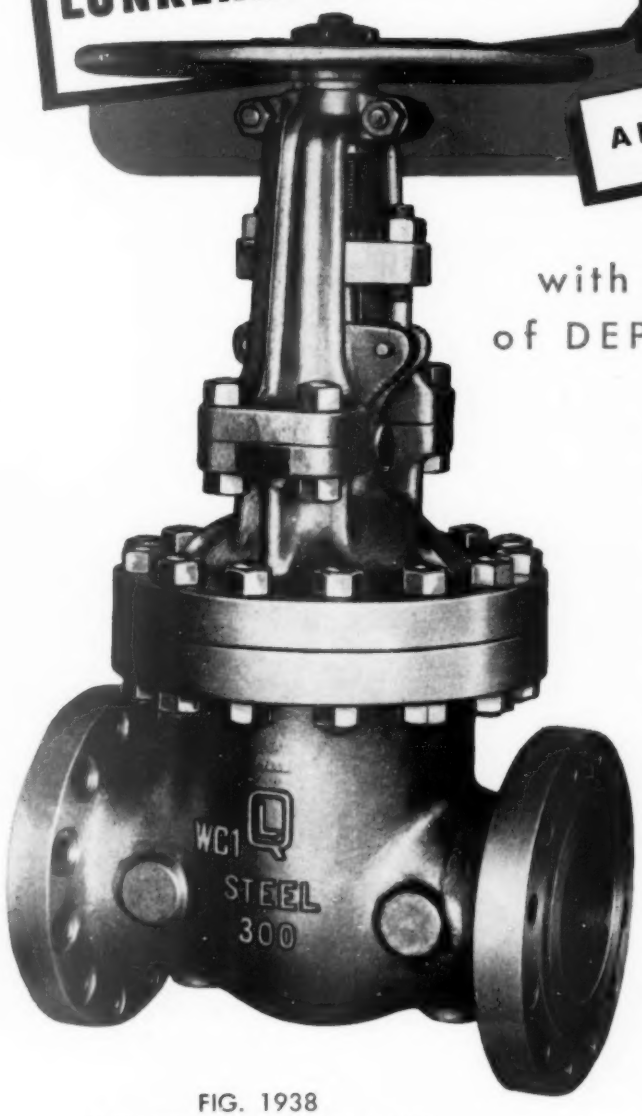

FIG. 1938
CAST STEEL WEDGE GATE VALVE
300 LB. S.P.

Particularly in the oil industry, it is not the price of the valve that counts —but the cost of replacing it. For 91 years, Lunkenheimer Valves have become more and more popular in the petroleum field, as users learned that they assure *lower ultimate costs.* For 91 years, Lunkenheimer Valves have proved themselves by providing longer wear with less repair in oil installations throughout the world. The Lunkenheimer Company, Box 360F, Cincinnati 14, Ohio.

LUNKENHEIMER
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QUALITY

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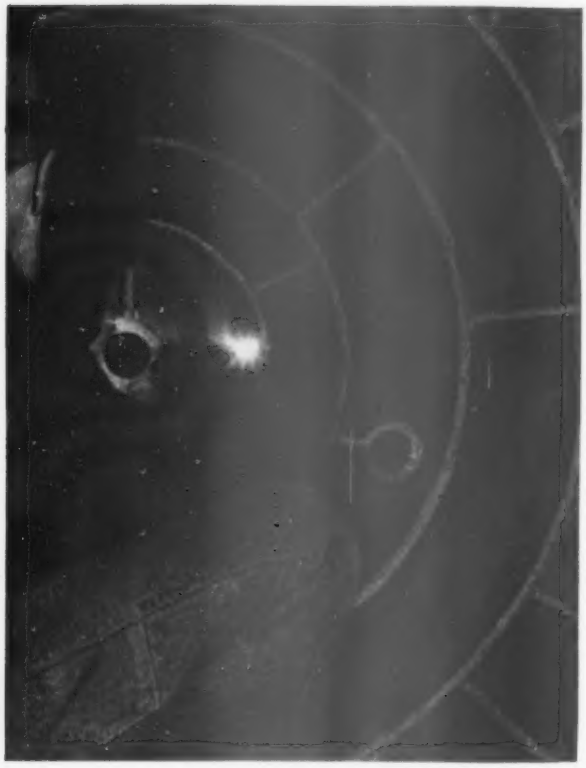
LUNKENHEIMER®

THE ONE *Great* NAME IN VALVES

L-653-14

How To Solve Corrosion Problems



PROBLEM: Protecting a preheater from corrosive attack during periodic contact with hydrochloric acid, trichlor benzene, and other chlorine compounds at 300 deg. F.

REMEDY: Complete lining with HASTELLOY alloy C 11-gage sheet.

RESULT: The vessel has given four years' service and is still going strong.

PROBLEM: Valving sulphur-laden flue gas at 800 deg. F. and 300 psi.

REMEDY: A ⅛-in. layer of HASTELLOY alloy B was applied to seats and seating surfaces.

RESULT: The valves gave over four years' service despite the corrosive conditions.

Free: Money-saving jobs like these are described in detail in the monthly magazine HAYNES ALLOYS DIGEST. To receive a copy regularly, write Editor, HAYNES ALLOYS DIGEST, Room 308, 30 East 42nd Street, New York 17, New York.

HASTELLOY *alloys*

Trade-Mark

Nickel-base, corrosion-resistant alloys available as sheet, plate, bar stock, welding rod, welded tubing and pipe, cast pipe and pipe fittings, sand and precision-investment castings.

"Hastelloy" is a registered trade-mark of Union Carbide and Carbon Corporation.

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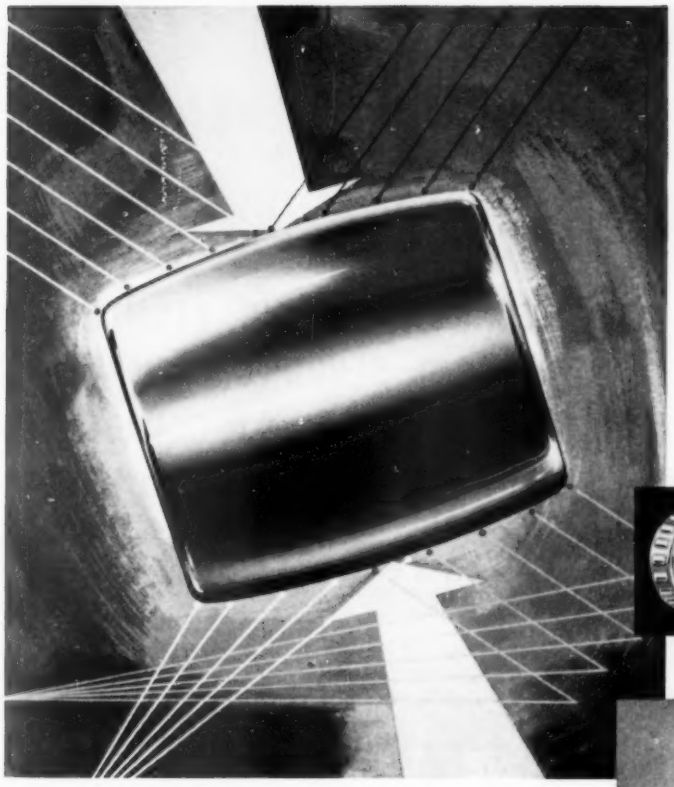

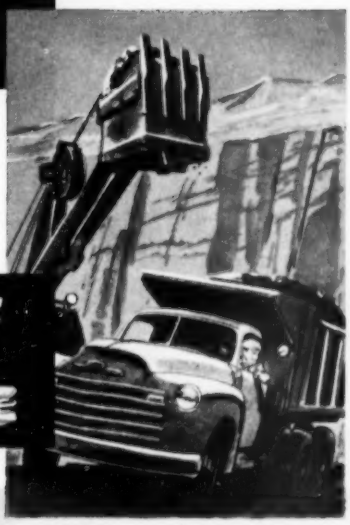

A new era in bearings is taking this shape...

NEW HYATT BARREL BEARING

now available in volume!

Industrial designers and engineers seldom make changes in bearing specifications. But when they discover something *really new*—like Hyatt's BARREL BEARING—out come the blueprints! *And this time they know they've got something!* Hyatt's new Barrel Bearing combines dual-purpose design with self-aligning action. It takes load from any direction and operates at full efficiency under conditions of misalignment! And, because barrel-shaped rollers provide high load capacity with low friction, this unique bearing is ideal for a wide range of applications. Best of all, the *cost* is far lower than you would expect! Find out how to improve *your* product . . . Consult a Hyatt Sales-Engineer, or write for our new Barrel Bearing catalog.

HYATT ROLLER BEARINGS

STRAIGHT · BARREL · TAPER

HYATT BEARINGS DIVISION • GENERAL MOTORS CORPORATION, HARRISON, N. J.

TRADE PAPER EDITION
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ENGINEERING News

JET APPARATUS • HEAT TRANSFER EQUIPMENT • STRAINERS • CONDENSERS AND VACUUM PUMPS • OIL BURNING EQUIPMENT • BAROMETERS • FLOW INDICATORS • RADIATOR TUBES • NOZZLES • SPRAY NOZZLES AND ATOMIZERS • GEAR PUMPS • DESUPERHEATERS

If You're PUMPING, HEATING, MIXING, SPRAYING, ATOMIZING LIQUIDS, Or If You're HANDLING SEMI-SOLIDS Or SLURRIES, Or If You MUST MOVE, COMPRESS, Or WASH AIR Or GASES And If CORROSION Or EROSION Present A Problem, Then...You NEED What We HAVE—

Information On SK JET APPARATUS

SK Jet Apparatus is used in thousands of process operations for performing one or a combination of the headlined functions. Here's why—

Jet Apparatus is exceedingly simple in design and construction, reliable in operation. There are no rapidly rotating parts to wear. It requires little maintenance. Jet equipment is unusually small in relation to the work it does and its cost is correspondingly low. Requiring little attention, a jet may be located in remote and inaccessible places. In many applications, it does what no other equipment can do—pumps *and* heats, entrains *and* scrubs, pumps *and* mixes.

Because Jet Apparatus is so simple in design, a wide range of *corrosion* and *erosion* resistant materials can be used in manufacturing. Depending upon the nature of the material handled, jets can be made from such materials as cast iron, bronze, porcelain, special stainless steels, hard lead, "Durimet," "Illium," "Haveg," "Teflon," Hastelloy, Titanium, stoneware, carbon, PYREX brand tubing, and others. Jet equipment can be lined with lead, rubber, phenolic resins, other materials.

Generally speaking SK Jet Apparatus includes all types and sizes of the equipment listed below, for which information is available. If you want literature on any particular type, use the coupon below. We'll be glad to supply it.

PLEASE SEND ME INFORMATION ON THE FOLLOWING:

- Steam Jet Syphons and Evacuators (2-A) ☐
- Water Jet Eductors, Agitators, Evacuators, Mixers (2-M) ☐
- Steam Jet Heaters for Liquids, Gas Holder Heaters and Sparger Nozzles (3-A) ☐
- Steam Jet Blowers and Blast Nozzles (4-AB) ☐
- Steam Jet Exhausters and Primers, Compressors and Agitators (4-E) ☐
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- Steam Jet High Vacuum Pumps and Apparatus (5-EH) ☐
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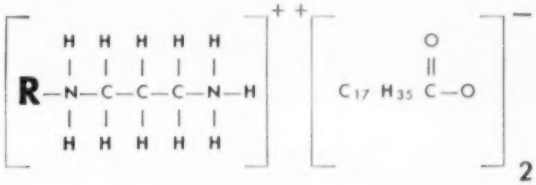
Representatives in Principal Cities

New Armour chemical cuts corrosion costs of primary wells

Major petroleum companies find Duomeen® T Dioleate more effective than dilute inhibitors — and lower in cost!

The latest development of the Armour Chemical Division's petroleum chemists is Duomeen T Dioleate—a potent corrosion inhibitor for "Down the Hole" treatment of primary producing wells. The ability of this new cationic surface active agent to convert steel surfaces from water-wettable to oil-wettable, thus forming a protective film, is the reason for the excellent protection provided by Duomeen T Dioleate.

Manufactured under exacting laboratory specifications, Duomeen T Dioleate is supplied *100% active*—water insoluble but readily soluble in common solvents. Particularly outstanding results have been obtained in controlling acid conditions in sour wells. Laboratory and field tests report 20 ppm of this chemical sufficient to gain maximum effectiveness. While this amount is reported as being successful, it is realized that specific locations and conditions may exist where greater concentrations are necessary. However, since Duomeen T Dioleate is supplied 100% active, it provides great flexibility by permitting the user to meet such conditions by making up any desired solution at the site. Duomeen T Dioleate also has application in other hydrocarbon systems and product lines. For the benefit of engineers who wish to know the chemical structure of this new and unique product, the structural formula for Duomeen T Dioleate is as follows:



Samples and complete data are readily available. Simply fill in and mail the coupon with your letterhead for free samples and a copy of our "Combat Corrosion" bulletin and Technical Bulletin E-6, "Chemical Treatment in Oil Wells."

Mail This Coupon With Your Letterhead

Armour Chemical Division
1355 W. 31st Street, Chicago 9, Ill.

Please send me:

- ☐ Samples of Duomeen T Dioleate
- ☐ "Combat Corrosion"
- ☐ Tech. Bull. E-6, "Chemical Treatment in Oil Wells"

Name .....

Title .....

Firm .....

Address .....

City ..... *Zone* ... *State* .....

ARMOUR CHEMICAL DIVISION

© Armour and Company • 1355 West 31st Street • Chicago 9, Illinois

Fractions
SOLVE BIG PROBLEMS

The petroleum industry has made good use of the "divide-and-rule" formula that conquered kingdoms . . . to win command of the giant powers hidden in nature's oil. The industry's process engineers have transformed American life by their mastery of petroleum's secrets . . . and fractionating has been their master key.

These engineers' ability to develop processes which break petroleum into its component fractions has harnessed the "black gold" into a myriad forms of service. There have been other important results, too. The gigantic motor industry . . . America's vast network of modern highways . . . the services to motor travel—these are largely by-products of the petroleum process engineer's knowledge of fractional distillation.

For many years, Sun Ship has been adding to its own prestige by the service and cooperation its great shops give to the petroleum industry, and to the many other industries which call on Sun Ship's versatile engineering and construction skills. It has built . . . for chemical and petroleum process engineers, and for refineries throughout the world . . . the immense fractionating towers, pressure vessels, special machinery and heavy equipment they require. The 95'7" crude tower shown in the photograph, ready for shipment, is a representative example.

Sun Ship's services will continue to keep pace with the giant strides made by the nation's industries in the engineering progress which is steadily building a greater America

Sun

SHIPBUILDING & DRY DOCK COMPANY

ON THE DELAWARE (SINCE 1916) CHESTER, PA.

25 BROADWAY • NEW YORK CITY

One of three hot piercing mills at Pittsburgh Steel, Allenport, Pa., works. This unit pierces a solid steel billet into its first shape as a seamless tube. One of the fastest automatic piercing mills in the industry, it produces tubes at speeds up to more than three feet per second.

Expansion Must Have Strong Foundations

When Pittsburgh Steel Company launched its $62.8-million Program of Progress, it had strong foundations to build on. These foundations consist of some of the most modern equipment in the industry for high-quality seamless tubular and wire products.

On the strength of these facilities, Pittsburgh Steel has kept rolling steadily ahead as it expanded its steelmaking capacity by 48% and began increasing its finishing facilities by 82%. Construction of its new hot-rolled sheet mill is complete, and by early next year a new cold-rolled sheet mill will be in production. Pittsburgh Steel will be entirely transformed into a new steel company.

Throughout this expansion, advances in the production of seamless tubes and wire products have kept pace. One example is the installation, at a cost of over $2 million, of the industry's fastest and most automatic seamless casing finishing line to speed production and improve the quality of finished seamless tubes. This and other improvements mean Pittsburgh Steel is better equipped than ever before to serve you with the products it has always made, as well as with the products it is making for the first time.

The entire production structure of the company has been strengthened . . . its market position has been improved, because it is able to offer a broader range of products . . . its earnings potential for stockholders has been increased . . . new advancement opportunities have opened up for its employees. You are watching the birth of a stronger new integrated steel producer . . . to serve the nation's peacetime industries, and if needed, to supply new muscle for defense.

Program of Progress

Acquisition of Thomas Steel	**100%** Complete
Increase of Blast Furnace Capacity by 12%	85% Complete
Increase of Open Hearth Capacity by 48%	**100%** Complete
Installation of new 66-inch High Lift Blooming-Slabbing Mill	**100%** Complete
Installation of Continuous 66-inch Hot Rolled Sheet-Strip Mill	**100%** Complete
Installation of 66-inch Cold Rolled Sheet-Strip Mill	80% Complete

"Everything New But the Name"

Pittsburgh Steel Company

Pittsburgh 30, Pennsylvania

JONES SUCKER RODS

Modern machines, new facilities and technical skill—backed by specialized engineering and metallurgical experience—tied closely to field operations. In capsule form, this is why Jones quality and service are always maintained at the peak level.

PESA

PETROLEUM EQUIPMENT SUPPLIERS ASSOCIATION

PARTNERS IN PETROLEUM PROGRESS

THE S. M. JONES COMPANY

Division of Buffalo-Eclipse Corporation

General Office and Factory: TOLEDO, OHIO

Sales Office: Kennedy Building, Tulsa, Okla.

Export Sales Office: Buffalo International Corp. 50 Church Street, N. Y. C.

LOOK FOR THE GREEN RODS

"where the wells are really deep, they sure like this packer"

"Down along the bayous, where anything short of 10,000 feet is shallow well digging — the men there tell me this BOCL packer is doing a wonderful job on those deep producers.

"That figures, because the BOCL was specifically designed for deep well operations, where tubing stretch is always a problem and bottom hole pressures can read like the national debt. Look at the packing element — 6 rings to give positive, leakproof pack-off against high pressures. And look at the long strike, the valve control you get with that extra-length mandrel — a full 30 inches between valve and seat.

"Of course, the BOCL has all the other Lane-Wells features, too — the dovetailed slips that *can't* get out to foul up a pulling job, the friction-proofed slip backs, the free-wheeling cage and the generous by-pass — just like all the other Lane-Wells packers. And believe me, they use lots of those, too, in Louisiana.

"Ask the men who are using 'em — or ask your Lane-Wells man!"

LANE WELLS COMPANY *Tomorrow's Tools - Today!*

AP-609

General Offices, Export Office, Plant • 5610 So. Soto St., Los Angeles 58

LOS ANGELES • HOUSTON • OKLAHOMA CITY • LANE-WELLS CANADIAN CO. IN CANADA • PETRO-TECH SERVICE CO. IN VENEZUELA

HEATING
COOLING
CONDENSING
EVAPORATING

Superior Heat Exchangers

are as often used for cooling as for heating . . . to reduce the temperature of cooling fluids for large Diesel engines, or gas line booster pumps; to cool exhaust gases; to maintain proper temperature of quenching and lubricating oils; to cool machine tool cutting fluids; and for a wide range of other cooling, heating, condensing and evaporating applications.

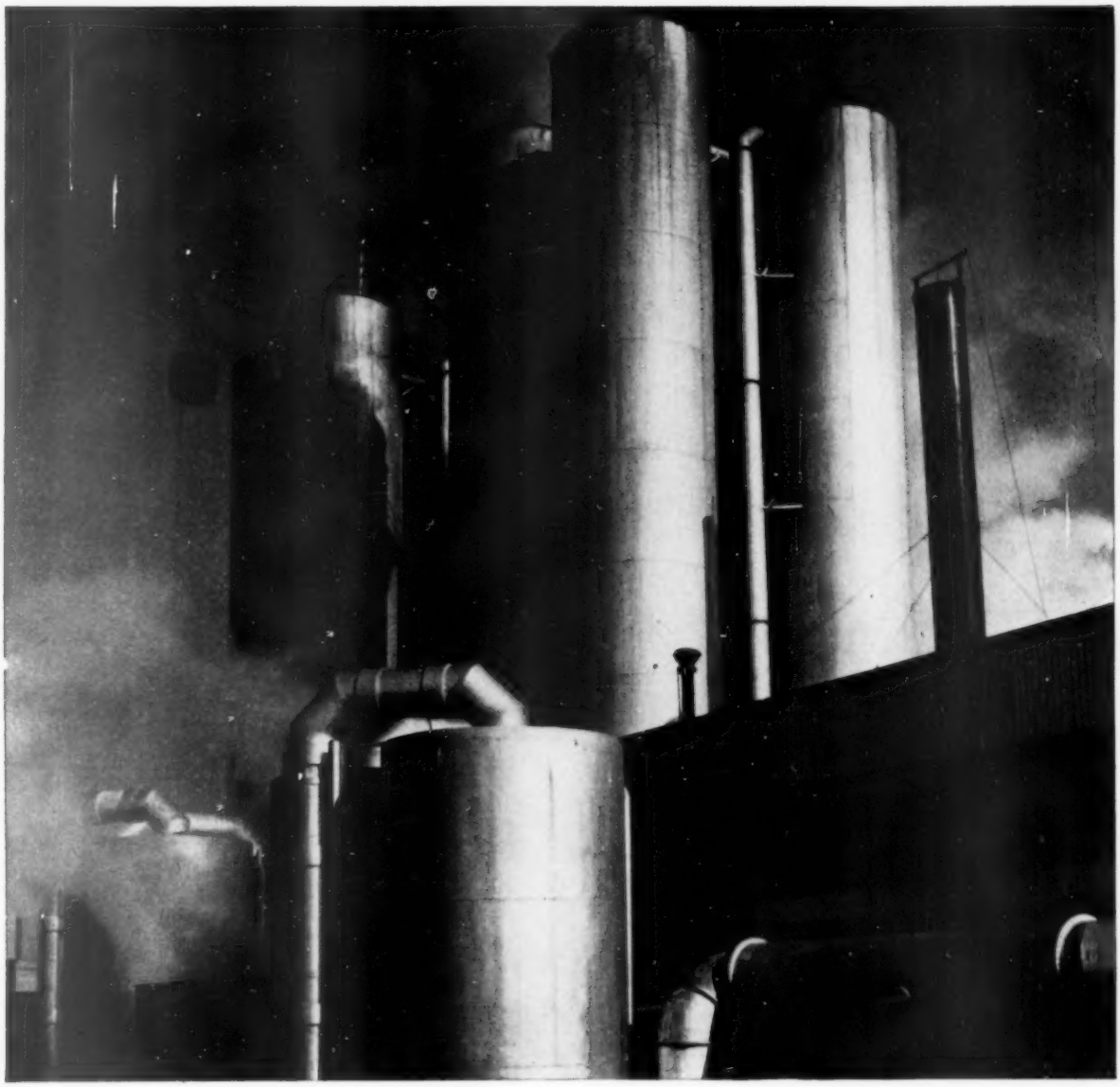
Superior's complete design and manufacturing facilities are geared to handle the most unusual as well as the more conventional requirements.

Our Engineering Department invites your inquiry on any proposed application as a basis for a specific engineering recommendation. Write for catalog 5011.

for performance you can **BANK** *on*

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR
HEAT EXCHANGERS



There's a special paint for places like this and it saves hundreds of dollars

When you get down to figuring how much it costs to paint a square foot of tank or stack, you find that the paint itself is only a small part of the cost. That's why experienced paint buyers select more quality aluminum paints for jobs like this than any other type.

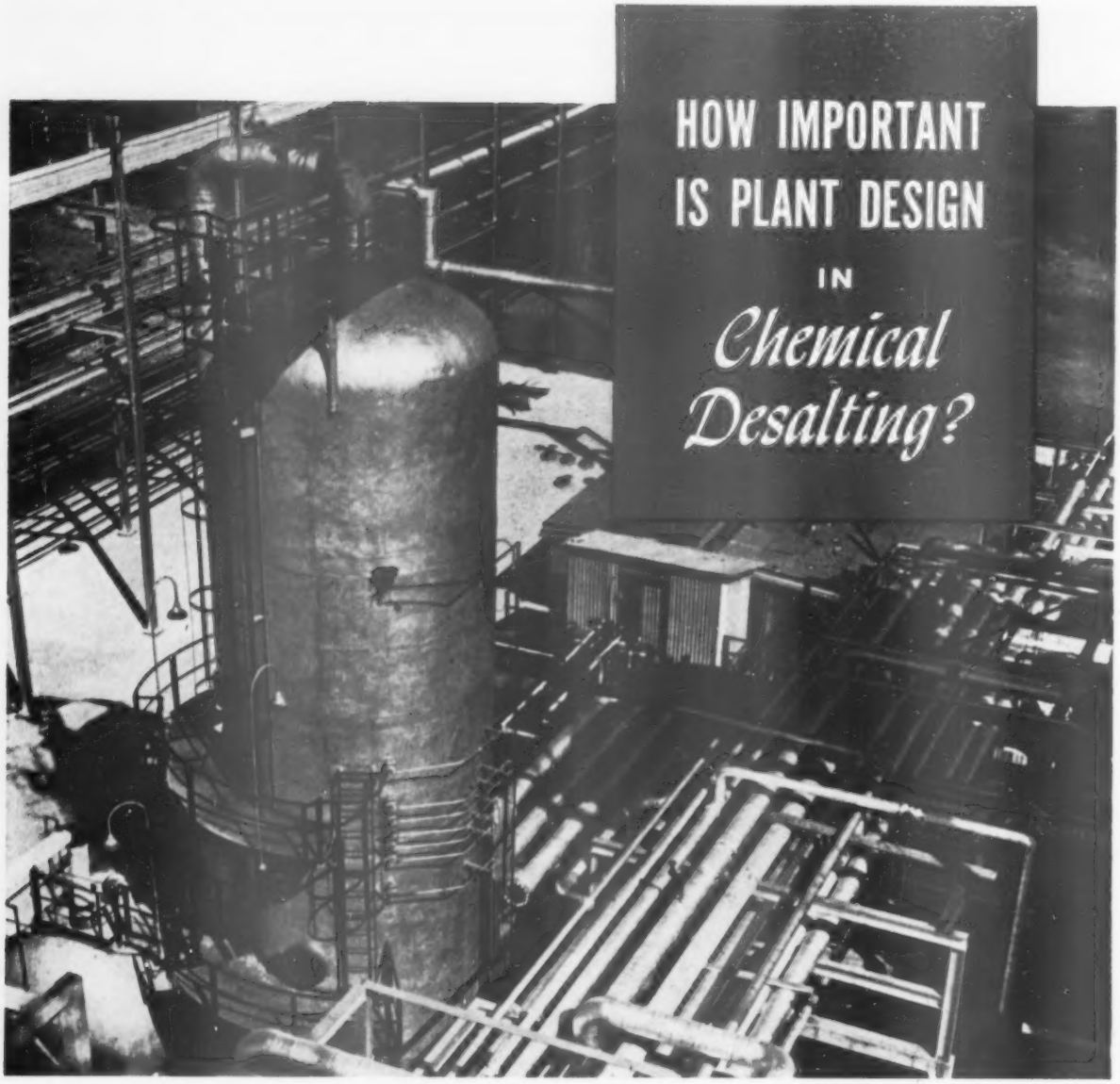
Because so much aluminum paint is used for these places, special formulas have been developed. Paints made to these formulas stand up longer under heat, cold, sun, rain and the kind of corrosive fumes you find around mills and factories.

We don't make paint. But we make the Alcoa Aluminum Pigments that are used in more aluminum paints than any other brand. So we want to be sure that you get full value from the aluminum paint you buy. It's just good business for us.

If you have a plant, or a stack, or storage tanks, or most anything else that needs paint that will last a long time, write us about your paint problem and we'll tell you what types of aluminum paints are best. We'll also send you a copy of *Painting with Aluminum*. It's packed with facts on selecting and using aluminum paints. Paint Service Bureau, Aluminum Company of America, 1791-L Alcoa Building, Pittsburgh 19, Pa.

Alcoa Aluminum

ALUMINUM COMPANY OF AMERICA



HOW IMPORTANT IS PLANT DESIGN IN *Chemical Desalting?*

At Tretolite, we believe plant design is almost as important as the selection of an effective desalting chemical. We also believe, and can cite many years of wide-spread Tretolite usage to prove our point, that we make the best chemical desalting reagents obtainable. At the same time, we know that to be completely effective, a desalting chemical must be properly used, in a correctly designed desalting plant. That is why the Tretolite Company offers a complete desalting service, from preliminary tests through plant completion, and from there on.

We firmly believe we *sell* the best desalting chemicals on the market. We know we *give* a desalting service that is unequalled in the chemical field. Don't be satisfied with less.

TRETOLITE COMPANY

Chemicals and Services for the Petroleum Industry

SAINT LOUIS 19, MISSOURI • LOS ANGELES 22, CALIFORNIA

DESALTING • DEHYDRATING • CORROSION INHIBITING
SCALE PREVENTING • WATER DE-OILING
PARAFFIN REMOVING

TD 53-3

10 POINTS That Spell

D U R A B I L I T Y

LARGE VALVE OPENINGS

DEEP STUFFING BOXES

BABBITT LINED SHELL BEARING

LARGE ROLLER BEARINGS

ALLOY STEEL CRANKS

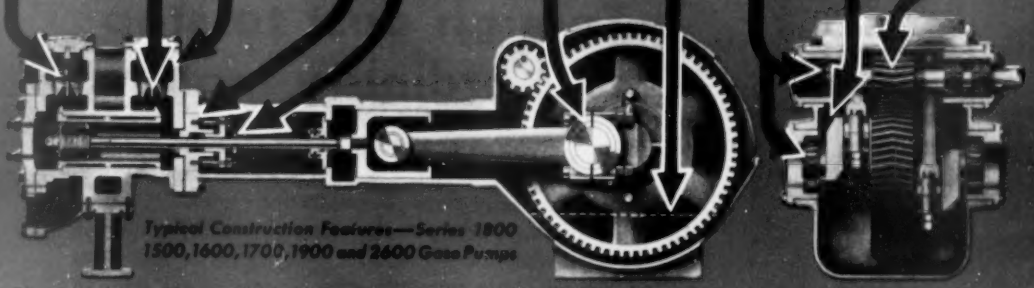
DURABLE FREE MOVING VALVES

INDIVIDUAL VALVE CHAMBERS

NO OVERLAPPING OF RODS

FLOOD LUBRICATION

ALLOY STEEL LAPPED HERRINGBONE GEARS



Typical Construction Features—Series 1800 1500, 1600, 1700, 1900 and 2600 Gaso Pumps

Here is the real secret of Gaso supremacy in pipe line pumps. It's *engineering*—engineering that starts with molybdenum alloy cast-iron with a tested tensile strength of 45,000 to 48,000 pounds per square inch, and extends to every detail of design. To specify Gaso is such a simple way to be SURE of the extra life and performance that sound engineering represents.

GASO PUMP & BURNER MFG. CO.

TULSA, OKLAHOMA

EXPORT OFFICE: 149 Broadway, New York

LUFKIN MACHINE CO., Ltd., Edmonton, Alberta

BUDA ENGINE & EQUIPMENT CO., Los Angeles, Calif. • Long Beach, Calif. • Bakersfield, Calif.

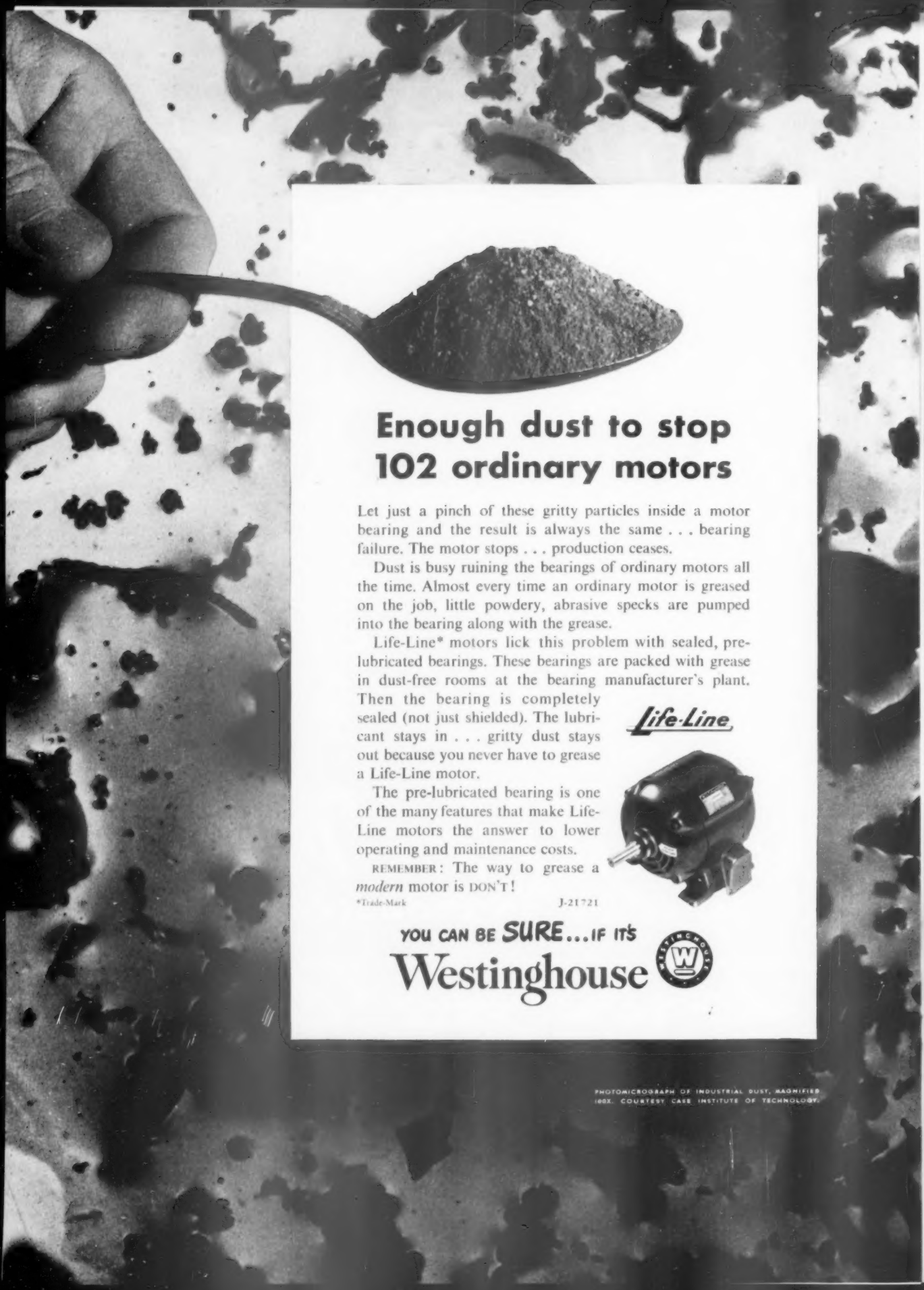
W. L. SONNER COMPANY, Shreveport, Louisiana • Tinsley, Mississippi • Beaumont, Mississippi • Odessa, Texas

PEDDLERS, INC., Houston, Texas

NORTEX ENGINE & EQUIPMENT CO., Wichita Falls, Texas

GASO PUMPS

for every oil industry need



Enough dust to stop 102 ordinary motors

Let just a pinch of these gritty particles inside a motor bearing and the result is always the same . . . bearing failure. The motor stops . . . production ceases.

Dust is busy ruining the bearings of ordinary motors all the time. Almost every time an ordinary motor is greased on the job, little powdery, abrasive specks are pumped into the bearing along with the grease.

Life-Line* motors lick this problem with sealed, pre-lubricated bearings. These bearings are packed with grease in dust-free rooms at the bearing manufacturer's plant. Then the bearing is completely sealed (not just shielded). The lubricant stays in . . . gritty dust stays out because you never have to grease a Life-Line motor.

Life-Line

The pre-lubricated bearing is one of the many features that make Life-Line motors the answer to lower operating and maintenance costs.

REMEMBER: The way to grease a *modern* motor is DON'T!

*Trade-Mark J-21721

YOU CAN BE SURE... IF IT'S

Westinghouse

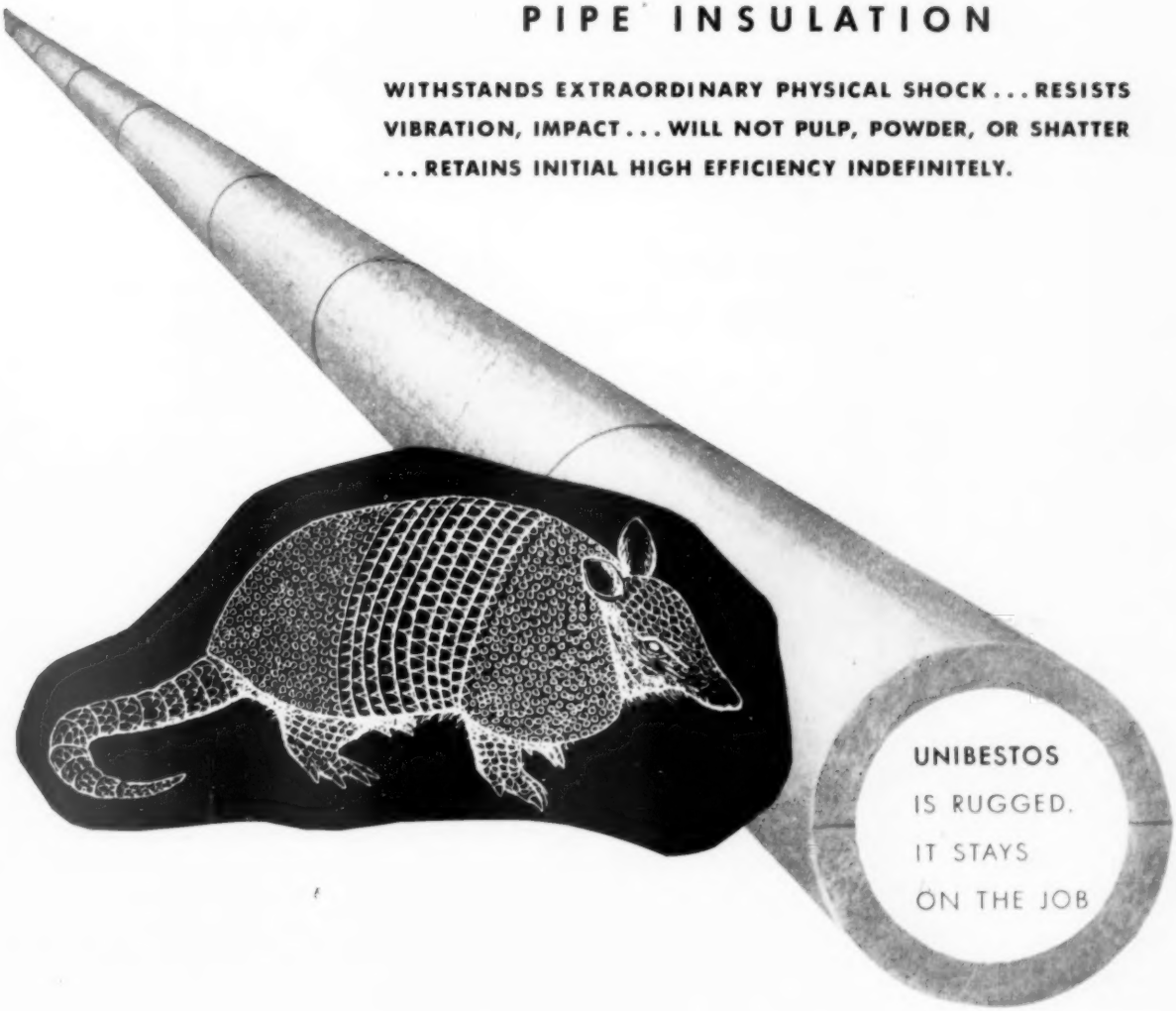
PHOTOMICROGRAPH OF INDUSTRIAL DUST, MAGNIFIED 100X. COURTESY CASE INSTITUTE OF TECHNOLOGY.

Needs no jacket

UNIBESTOS®

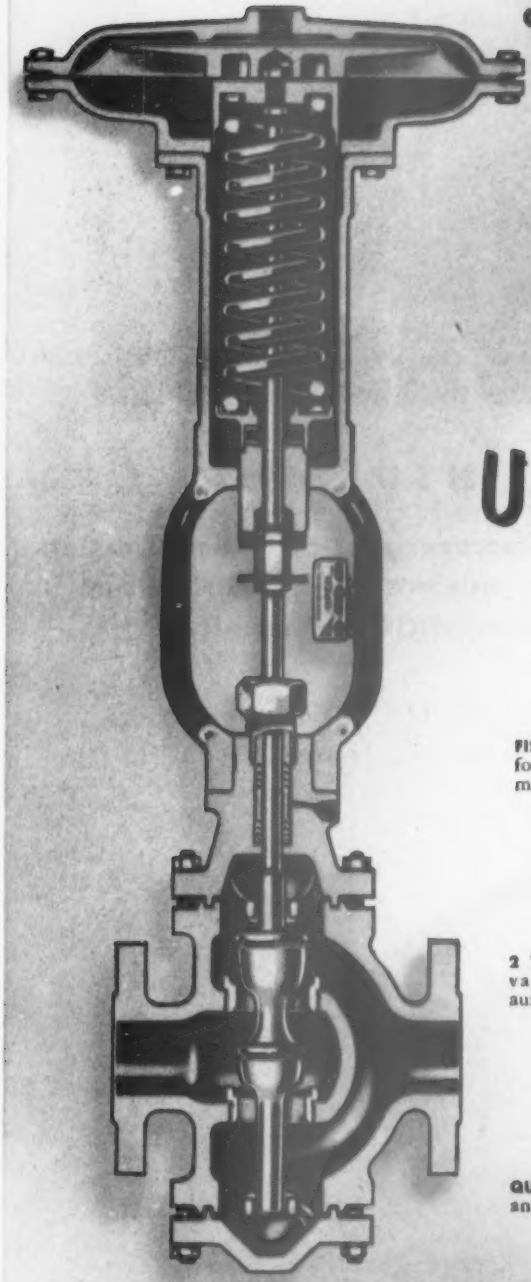
PIPE INSULATION

WITHSTANDS EXTRAORDINARY PHYSICAL SHOCK... RESISTS VIBRATION, IMPACT... WILL NOT PULP, POWDER, OR SHATTER ... RETAINS INITIAL HIGH EFFICIENCY INDEFINITELY.



UNARCO **UNION ASBESTOS & RUBBER COMPANY**

DEPT. E-11, 332 SOUTH MICHIGAN AVENUE, CHICAGO 4, ILLINOIS

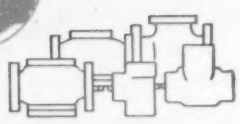


Exclusive features of design plus quality controlled materials and workmanship are the reasons

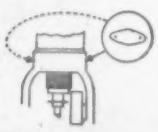
FISHER®

Diaphragm Motor Valves are Universally Preferred

FISHER ALLOY SPRINGS are tested for load tolerances of plus or minus 2½%.



VARIETY OF BODY TYPES and materials—iron, steel, bronze, alloys, single and double seated, angle and globe.



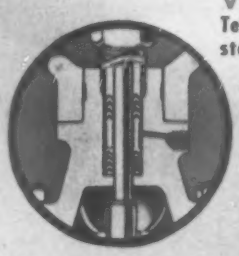
2 YOKE MOUNTING PADS for valve positioner and other auxiliary equipment.

WIDE CHOICE OF INNER VALVES to provide desired flow characteristics.

QUALITY CONTROLLED materials and workmanship.

WALL SECTIONS conform with ASA fittings code.

Fisher offers the most versatile and complete line of Diaphragm Motor Valves—manufactured to handle pressure conditions up to 6,000 pounds. Available in metals for highly corrosive service and alloys for high temperature work. They are built for your specific requirements.



VERSATILE! ECONOMICAL!

Teflon V-Ring Packing, requiring no lubrication, is standard on all Fisher Diaphragm Motor Valves

Dual Teflon packing also available. 2 sets of packing separated with bleed area where purge zone is desired. Positively prevents outbound leakage—or inbound leakage under vacuum service. For dangerous toxic, corrosive, etc. applications.

FISHER

FISHER GOVERNOR COMPANY • Marshalltown, Iowa

LEADS THE INDUSTRY IN RESEARCH FOR BETTER PRESSURE CONTROL

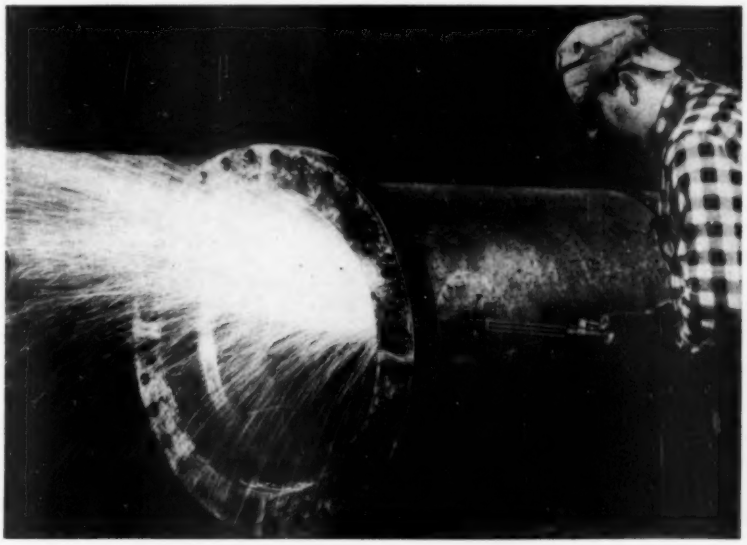
PROCESS EQUIPMENT NEWS

PUBLISHED BY FABRICATED PRODUCTS DIVISION, THE M. W. KELLOGG COMPANY NOVEMBER 1953

Shop Stream-lined to Raise Capacity

Stream-lining of Kellogg's heat exchanger fabrication facilities is continuing as new equipment is installed in a program aimed at providing production-line manufacture of tubular heat transfer equipment.

As a result of this program, which also includes the rearrangement of existing equipment and layout, Kellogg has been able to accelerate the production of the wide variety of units regularly coming into the shop. For example, a recent order for 200 stainless steel heat exchangers with shells 48 inches inside diameter and tube bundles having 20 foot tubes, was completed in less than 18 months after the order was received.



Large Tube Sheet for Chemical Plant Heat Exchanger

When drilling and machining is completed, this large aluminum-killed forged-steel tube sheet will become part of a heat exchanger destined for service in a chemical plant operated by a major U. S. processor.

The unit, 60 inches inside diameter and 18 feet long, and containing 5900 sq. ft. of effective tube surface is designed to operate at 8°F on the shell side and 17°F on the tube side.

Cutting Accurate Bevel in Nozzle Hole Essential to Efficient Welding

While there is no unusual skill required in shaping a nozzle hole in an exchanger shell when its outline and location have been clearly indicated by a qualified layout man, it is quite a trick to cut these holes with the proper bevel to produce a perfectly welded joint when the nozzle is attached.

Here, one of Kellogg's highly skilled craftsmen is cutting the inlet nozzle hole in a crude preheater scheduled for installation in a large Gulf Coast refinery. When installed it will exchange heat from a naphtha cut with crude entering a topping still.

The shell, $\frac{7}{8}$ inch thick, has an inside diameter of 27 inches. It will contain a tube bundle having 255 one-inch steel tubes on a $1\frac{1}{4}$" square pitch.

Chrome-Moly U-Tube Bundle for Reboiler

For further information, details of methods, etc. contact
FABRICATED PRODUCTS DIVISION
THE
M. W. KELLOGG
COMPANY
225 Broadway, New York 7, N. Y.
or offices in Jersey City, Buffalo, Los Angeles, Tulsa, Houston, Toronto, London & Paris
KELLOGG PULLMAN

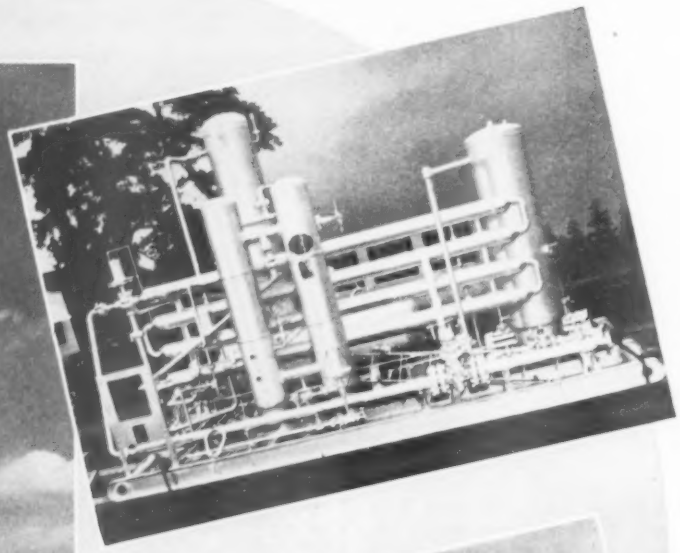
This U-tube bundle for a cracked gasoline stabilizer reboiler will soon see service in a small refinery in the Southwest.

The bundle, fabricated from 4-6% Cr, ½% Mo corrosion-resistant steel, is approximately 15 feet in length and will be inserted in a kettle type shell.

The unit is designed for temperatures up to 600°F on the tube side and 400°F on the shell side while processing corrosive materials. Design pressure on both sides is 250 psi.

PARKERSBURG HYRECOS..

...are designed to fit *YOUR* wells, not just *ANY* well!



For maximum profits and the most efficient and trouble-free operation, you need a cold separation unit that is built to deliver outstanding performance on YOUR well . . . not just a "good" job on almost ANY well.

This is exactly what Parkersburg Hyrecos are designed to do. Each one is a combination of basic elements assembled to fit ONE SPECIFIC APPLICATION.

Parkersburg, inventor and pioneer of cold separation, has proved by years of experience and trial that no one combination can possibly fit all applications . . . a "universal" cold separation unit is as impossible as a universal hat.

Ask your Parkersburg Representative for complete data on the correct Hyreco installation for your cold separation problem.

PARKERSBURG
Pioneer and Leader in
COLD SEPARATION

PESA

No. 5312

PARKERSBURG
PRESSURE EQUIPMENT

HORIZONTAL AND VERTICAL SEPARATORS • HYRECO • HYDRACEPTER • SCRUBBERS • TREATERS • HEATERS

Manufactured in Houston, Texas

you'll want this catalog on Self-Priming Centrifugal Pumps

Here's a new catalog you'll surely want. It gives you all the details on Rex Speed Primer Pumps for oil field use. Rex offers a complete line of self-priming centrifugal oil field pumps in capacities ranging from 4,000 gallons per hour to 90,000 gallons per hour. There are gasoline-powered pumps, electric motor driven pumps and pumps without power arranged for belt drive.

You'll find complete specifications, application information, details on construction and operation plus many interesting application photos. You'll learn why—when it comes to oil field pumps—your best buy is Rex. Just mail the coupon.

IT'S FREE!

Chain Belt Company
4619 W. Greenfield Ave.
Milwaukee 1, Wisconsin

53-315.A

Gentlemen: Please send me Bulletin 53-37 on Rex Speed Primers.

Name.....

Company.....

Address.....*Dept.*.....

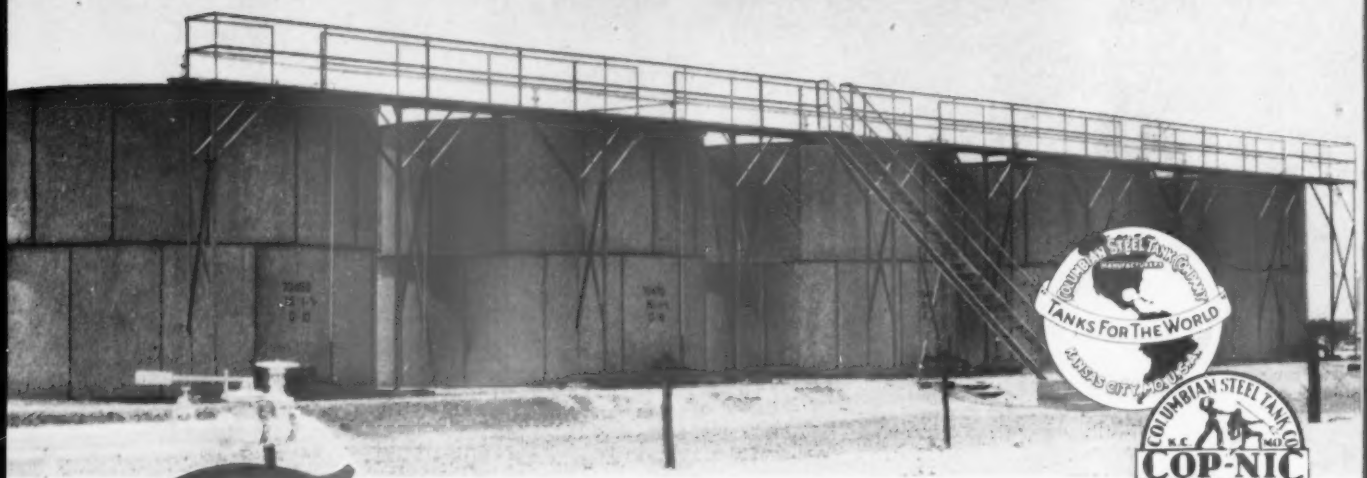
City.....

.....*State*.....

CHAIN BELT REX COMPANY

SPEED PRIMER PUMPS

FIRST with API TANKS of Every Size



COLUMBIAN
BOLTED STEEL TANKS

Years ago when the American Petroleum Institute decided on standard specifications for API tanks, COLUMBIAN immediately developed API tanks in every size. Today, COLUMBIAN continues this leadership in storage tank design and fabrication and remains FIRST in the minds of oil producers all over the world. Because exclusive construction features, easy assembly and long life service mean extra value in every COLUMBIAN tank.

COLUMBIAN ALL-METAL BUILDINGS are proved money-savers as warehouses, engine houses, garages, equipment and storage houses. Rigid, strong, fire-safe, low upkeep. Write for complete facts.

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Westex Tank Company
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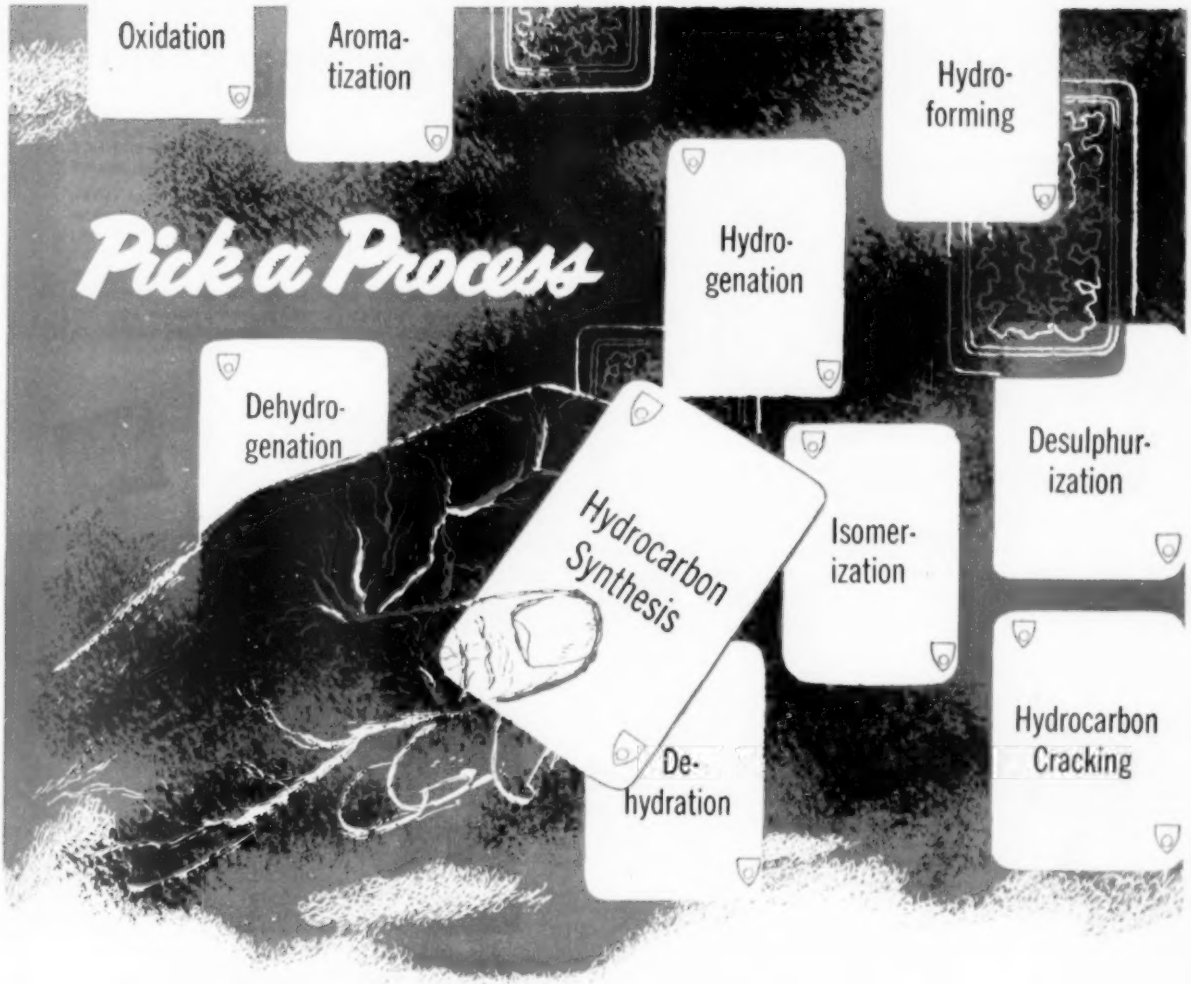
Columbian Steel Tank Co.
(Warehouse)
3705 McKinney Ave.
Houston, Texas

B. A. Box
P. O. Box 42
Beeville, Texas

WYOMING
O'Neill Tank Company
P. O. Box 154
Casper, Wyoming

COLUMBIAN STEEL TANK CO., P. O. Box 4048-J, Kansas City, Mo.



ALCOA ALUMINA Catalysts

and Catalyst Supports give **bigger yields . . .** **better quality**

If you want to up-grade your catalytic process yields, or simply reduce losses from contamination and side reactions, you'll find it advantageous to insist on ALCOA Aluminas for your catalysts and catalyst supports.

ALCOA Aluminas—*Activated*, *Tabular* and *Calcined*—help produce better end products at lower costs because they permit close control over rates of reaction . . . reduce carbon-deposit difficulties . . . often lower operating temperatures.

ALCOA Aluminas are uniform in structure and chemical purity . . . stable at elevated temperatures . . . have high resistance to erosion and crushing . . . and are moderate in cost.

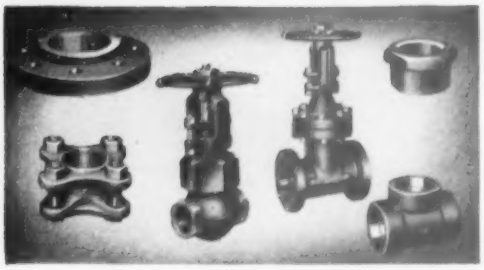
Let us send you further information and samples for testing in your own plant. Write to ALUMINUM COMPANY OF AMERICA, CHEMICALS DIVISION, 718-L Alcoa Building, Pittsburgh 19, Pa.

See our advertisement in Refinery Catalog and Chemical Materials Catalog. For corrosion-resistant heat exchanger tubes, instrument tube, process equipment and architectural items, investigate ALCOA *Aluminum.*

Alcoa Chemicals

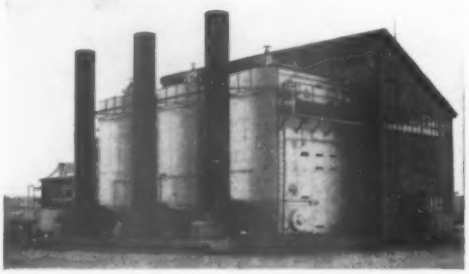
ALUMINUM COMPANY OF AMERICA

Designed for today's *Tough* service demands



DROP FORGED VALVES AND FITTINGS FOR TOUGHNESS AND TROUBLE-FREE SERVICE

Drop forged from carbon and alloy steels, Vogt valves, fittings and flanges will safely handle liquids and gases at high pressures and high temperatures in power plants, chemical plants, petroleum refineries, etc. The complete line includes flanged, screwed and socket weld end globe, gate and check valves—ells, tees, and crosses—couplings—bushings—plugs—unions—flanges and flange unions—and welding heads.

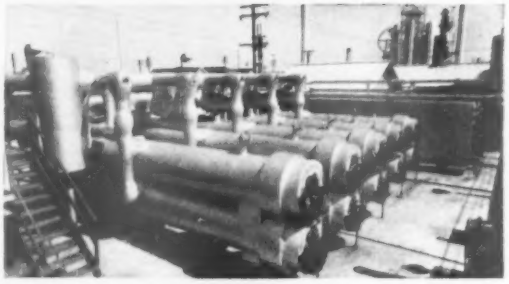


MODERN STEAM GENERATORS

Vogt steam generators are designed to give maximum rating in a minimum of space, with high efficiency and low maintenance expense. Bent tube types and straight tube, forged steel sectional header types to burn solid, liquid or gaseous fuels meet every power, process or heating requirement.

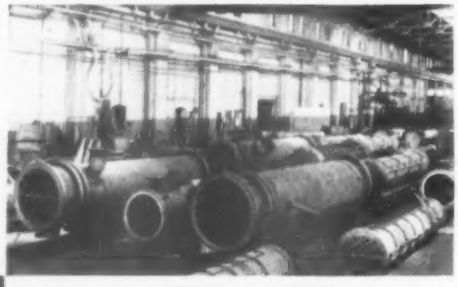
PROCESS EQUIPMENT FOR EVERY SERVICE

Vogt constructs process equipment in wide variety to all Codes. Stills and towers, oil chillers, crystallizers, heat exchangers, molding machines, etc., serve in the manufacture of oils, greases, 100 octane gasoline, synthetic rubber, chemicals and related products around the world.



SPECIAL MATERIALS COMBAT CORROSION AND PRODUCT CONTAMINATION

Our modern shops produce a wide variety of equipment from special metals and alloys to fight corrosion and product discoloration or contamination. Fabrication procedures insure that corrosion resistant properties of welds will match that of the materials used to construct the equipment.



MORE REFRIGERATION TONNAGE AT LESS COST

More than 70 years of engineering and manufacturing experience is incorporated in Vogt refrigerating and ice making equipment. Absorption Systems, Compression Systems, and Tube-Ice Machines in a wide range of capacities serve industrial and processing plants, and institutions, here and abroad.

Vogt

PRODUCTS

FOR REFINERIES, CHEMICAL PLANTS POWER PLANTS AND PROCESS INDUSTRIES

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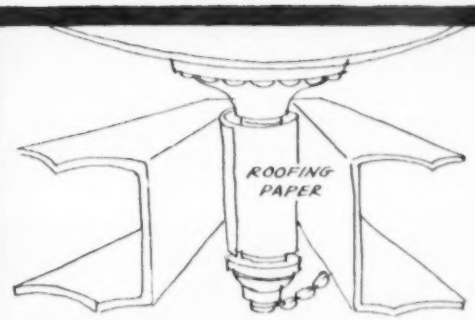
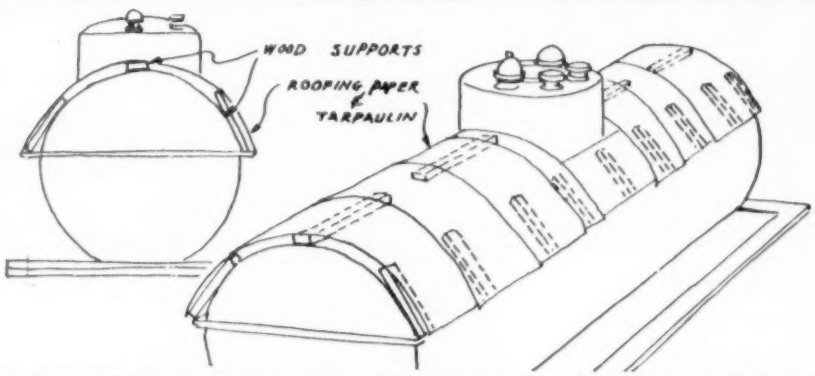
from Monsanto
technical service

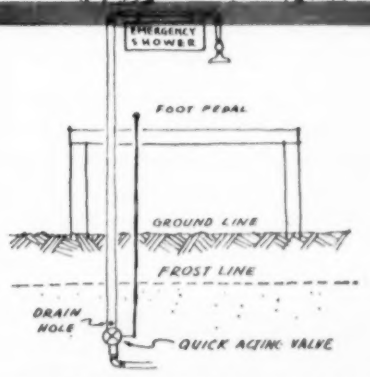
3 Tips on How to Handle Phenol More Easily



FASTER UNLOADING IN COLD WEATHER is made possible by simple cylindrical shield of roofing paper or cardboard around boot. Shield aids unloading by confining steam from hose to localized area, thus warming entire section to promote rapid melting. This procedure may save you plenty of valuable time in cold weather.



ELIMINATE "FREEZE-UPS" AT TOP OF CAR by spreading tarpaulin or covering of roofing paper over top of tank car. This easy-to-use procedure will promote rapid melting of phenol on the hard-to-reach upper surfaces of the car shell.



ALL-WEATHER SAFETY SHOWER placed at unloading facilities gives added insurance against worker injury. It can be constructed easily as shown in diagram and should have a valve below the frost line as well as a small drain hole above the valve. Such a shower will not freeze even in coldest weather.

FOR MORE HELP ON PHENOL HANDLING *write to our technical service, MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 800 North Twelfth Blvd., St. Louis 1, Missouri.*

PHENOL

MONSANTO
CHEMICALS — PLASTICS

SERVING INDUSTRY... WHICH SERVES MANKIND

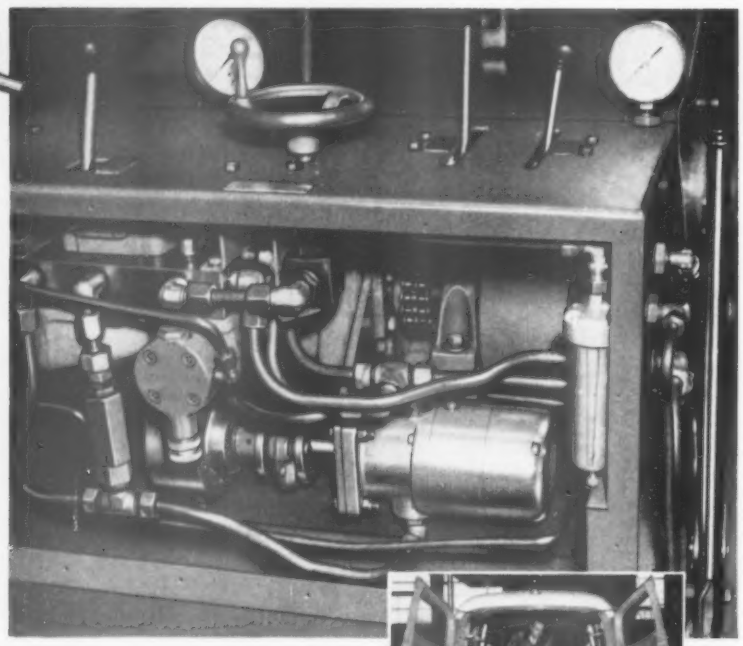
Schlumberger Perforating Truck uses

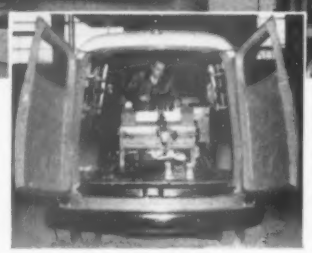
DENISON HydrOILic Controls

FLUID MOTOR

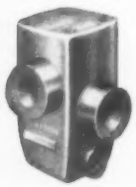
SEQUENCE VALVE

4-WAY DIRECTIONAL CONTROL

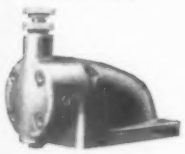




PUMP MOTOR



CHECK VALVE



RELIEF VALVE

Large photo shows the hydraulic power unit from the operator's side, with cover removed. Note the simplicity of this versatile unit, eliminating excess piping through subplate mounted components. At left, the operator is ready to put the rig in operation.

The compact hydraulic power and control assembly in this gun perforating unit leaves plenty of room to spare in the ton-and-a-half panel truck operated by the Schlumberger Well Surveying Corporation.

Yet it furnishes 9 hp to a cable drum which handles 11,000 feet of 3/16-inch cable supporting the expendable shape charge gun.

The drive has the advantage of ***infinitely adjustable speed control.*** The operator can go in the hole at whatever speed the gun will drop, come out at speeds up to 35,000 feet per hour, and move up or down as slow as 500 feet per hour while positioning for the shot. Torque on the drum is always adequate to pull the rope socket when necessary.

Shown above are some of the many Denison HydrOILic components used in making up this hydraulic drive. Others include a sequence valve and a throttle valve. All valves are of the subplate mounting type, which reduce piping needs to the minimum.

DENISON HydrOILics

Denison hydraulic pumps, motors and controls are rapidly gaining wide acceptance for all kinds of oil field applications, because they offer the compact efficiency and ruggedness needed for these exacting heavy-duty demands. You too may find the solution to many needs for closely adjustable power and control, in Denison's wide range of HydrOILic components for heavy-duty use at pressures up to 5000 psi. Please write for complete information.

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Telephone: Justin 6232

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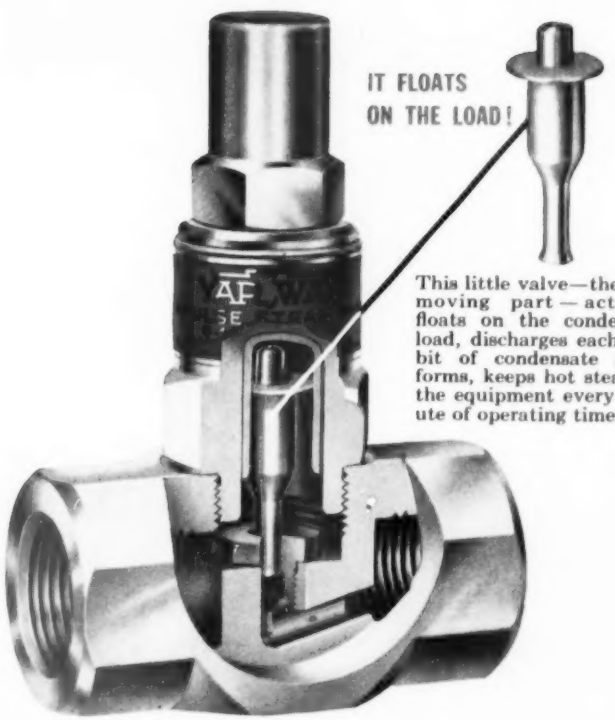
3000 impulses help keep mid-west refinery "on stream"



This little valve—the only moving part—actually floats on the condensate load, discharges each tiny bit of condensate as it forms, keeps hot steam in the equipment every minute of operating time.

THIS big refinery at Lawrenceville, Ill.—like a lot of other important refineries — uses Yarway Impulse Steam Traps.

Over 3000 Yarway Impulse Traps are installed on tracer lines and for draining steam headers.

Popular features of the Yarway Impulse Steam Trap are its ability to get equipment *hot in a hurry*—and keep it hot! . . . also its small, handy size—fits in easily in any location; its stainless steel body and working parts; quick installation; easy maintenance; low initial cost.

Another advantage—IMMEDIATE DELIVERY from 250 local distributors, plus quick service from nearby Yarway field engineers.

More than 900,000 Yarway Impulse Steam Traps have been sold. For a free Steam Trap Selector, write . . .

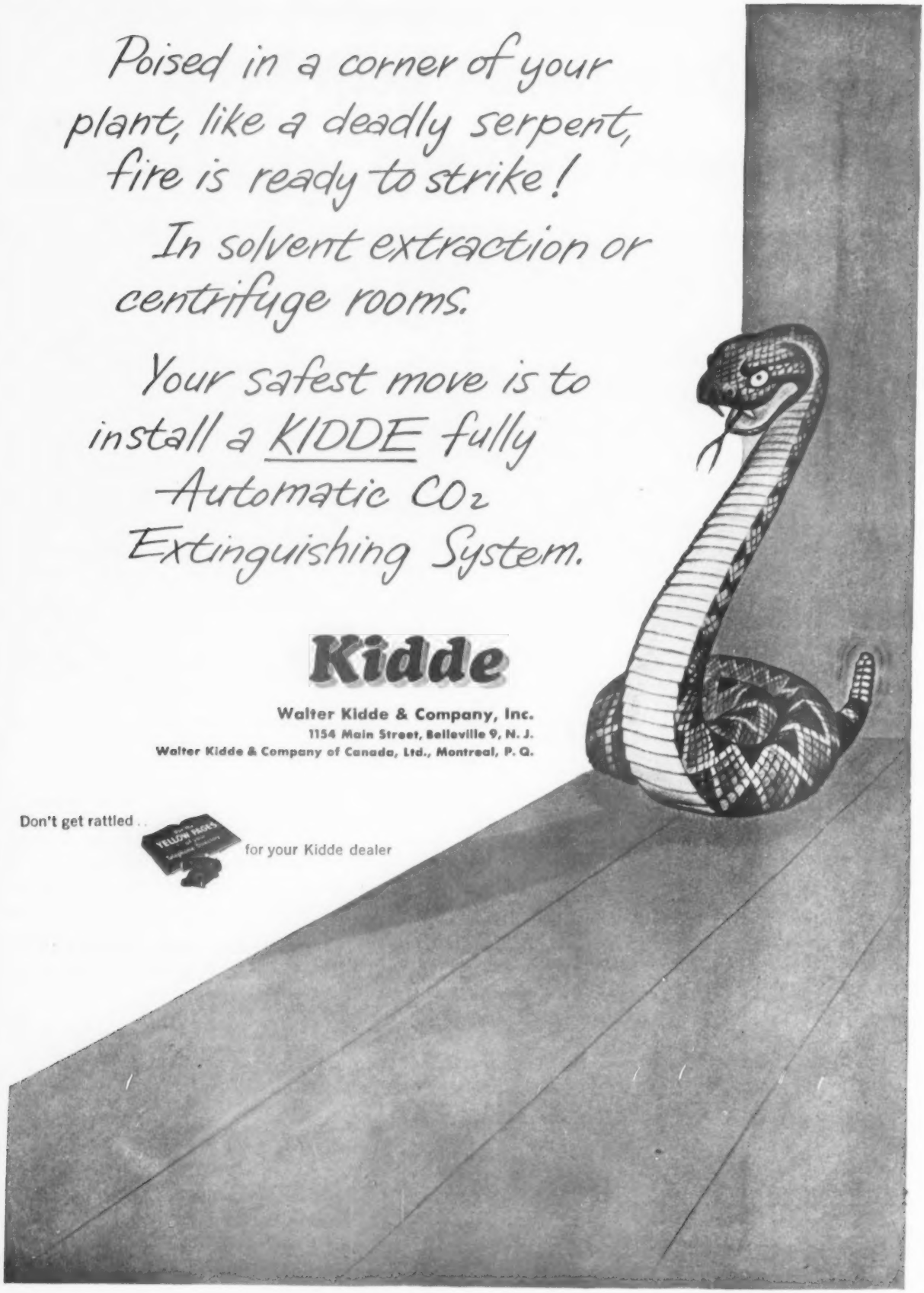
YARNALL-WARING COMPANY
136 Mermaid Ave., Philadelphia 18, Pa.

YARWAY impulse® steam trap

Poised in a corner of your plant, like a deadly serpent, fire is ready to strike!

In solvent extraction or centrifuge rooms.

Your safest move is to install a KIDDE fully Automatic CO_2 Extinguishing System.



Kidde

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Don't get rattled . . . for your Kidde dealer

This Simple Compressor Meets the Complex Needs of a Changing Petroleum Industry

It's the Nash!

Here is a compressor presenting advantages found in no other device. Nash Compressors have only one moving part, rotating without metallic contact with the pump casing. No internal lubrication is required. Yet they produce 75 lbs. pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure.

There are no valves, gears, pistons, sliding vanes, or other complicated wearing parts in a Nash. Compression is secured by an entirely different principle of operation. Because of this, gas pumping problems difficult with ordinary pumps are often easily handled by the Nash. For example, Nash Pumps are standard equipment in the Synthetic Rubber Industry, where they have met the needs of new and difficult processes.

Nash Compressors are compact and save space. They run without vibration, and compression is without pulsation. They maintain original performance over long periods. Service is assured by a nationwide net-work of Engineering Service offices. Instructive bulletin shows how they operate. Write for it.

One moving part.

No internal wearing parts.

No valves, pistons, or sliding vanes.

No internal lubrication.

Low maintenance.

Slugs of liquid entering pump do no harm.

Non-pulsating pressure.

Saves floor space.

75 pounds in a single stage.

NASH ENGINEERING COMPANY

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The straight, smooth inside bore of rugged CP Drill Collars eliminates washouts caused by offsets. Uniform outside hardness for the entire length of the collar greatly reduces rotation wear. Concentric, uniform thickness of wall sections provides rigidity throughout and perfect balance to overcome whipping and warpage — assures equal stress at all connections.

Threading is tailor-made to your specific requirements—all threads are hobbed on a thread mill for perfect uniformity and alignment. Available on special order in any length up to 55 feet. Write for Drill Collar Manual. *Chicago Pneumatic Tool Company, Oil Tool Division, 5000 U.S. Route 81 South, Fort Worth, Texas.*

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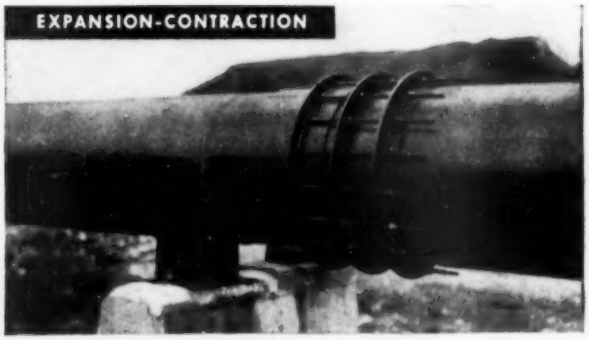
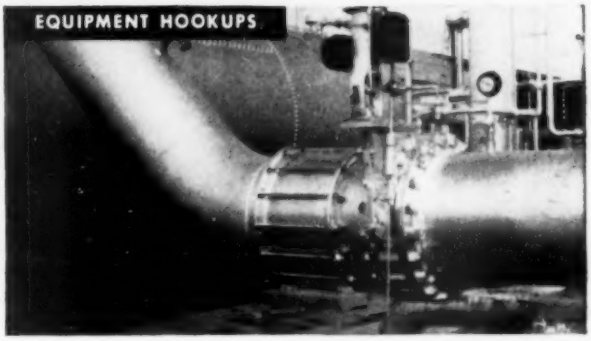
IN THE OILFIELDS . . .

the DRESSER way is *easier . . . surer!*





As an oilman, you're interested in joining pipe quickly . . . maintaining tight joints . . . making fast repairs with minimum losses and shutdowns. Using Dresser Couplings and repair products, you can do just that.

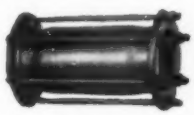
Dresser Couplings or Long Sleeves go together simply and quickly. Resilient Dresser Gaskets assure flexible joints which absorb settlement, other movement . . . on well and separator piping . . . salt-water lines . . . tank, pump, engine and compressor connections.

When a split, break or leaking joint occurs, Dresser Clamps and Sleeves turn an emergency into a simple repair job—completed in a matter of minutes *without shutdowns.*

You'll find there's a Dresser product for every condition and requirement affecting oilfield pipe lines, and that the DRESSER way is *always* easier, surer.

AVAILABLE AT ALL LEADING OILFIELD SUPPLY STORES

Style 38
Coupling


Style 40
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Style 63
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Style 55
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ALSO COLLAR LEAK CLAMPS, HIGH PRESSURE REPAIR SLEEVES

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ALLOWS LINES TO WALK WITH TANK

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Heat . . . cold . . . tank settling . . . all made rigid pipe on oil storage tanks in a large New England bulk plant move, bend and break. Every break meant oil and gasoline lost . . . fire a constant threat.

Then Penflex "Flexineering" solved the problem. Pipe breakage has been eliminated with a length of 12" I.D. four-wall interlocked, specially packed Penflex tubing . . . installed with tight-packed flanges. Now any amount of thermal expansion or tank settling can occur with no leaks, breaks or spillage. Penflex tubing is tight as a pipe . . . yet flexible under all conditions.

Let Penflex engineers help solve your tubing problems. Penflex manufactures a complete line of four-wall interlocked and seamless welded corrugated flexible tubing . . . metallic hose, tubing or couplings from $\frac{1}{8}$" I.D. and up . . . automatic barrel fillers, accessories and fittings.

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PENFLEX
HEART OF INDUSTRY'S LIFE LINES

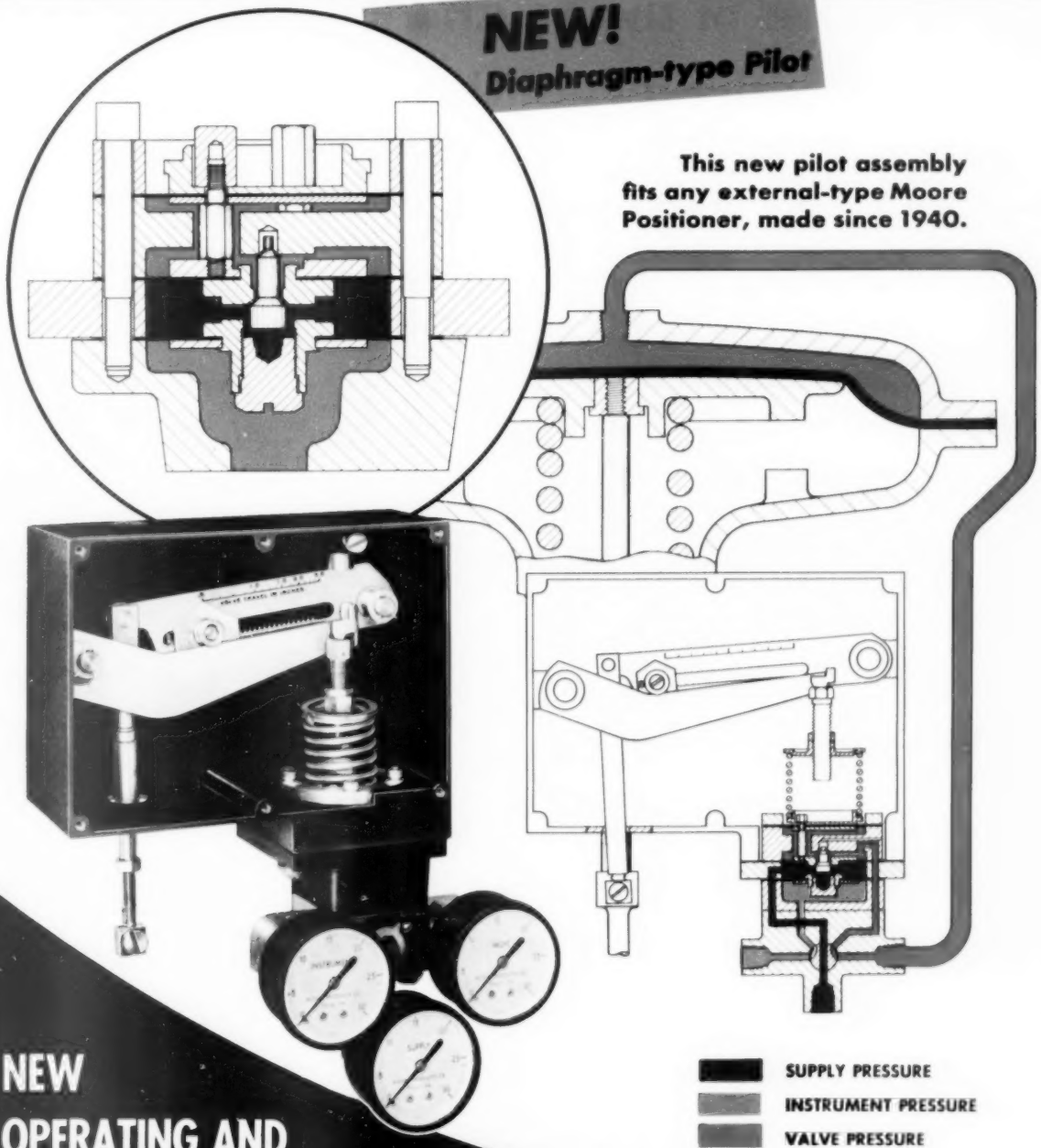
MOORE PRODUCTS CO.
PHILADELPHIA 24, PA.

MOORE VALVE POSITIONER

BULLETIN 7005
Model 721

NEW! Diaphragm-type Pilot

This new pilot assembly fits any external-type Moore Positioner, made since 1940.



NEW OPERATING AND CONSTRUCTION FEATURES

CAPACITY increased four times

STABILITY inherent in new pilot design

AIR CONSUMPTION in a balance position is reduced to one-third

THROTTLING RANGES FOR DIFFICULT APPLICATIONS—1% nominal range of standard positioner is easily changed to 5%, 10% or 20%

DIAPHRAGMS built to withstand severe vibration

RANGE-SPRING PIVOT designed to eliminate hysteresis

PRACTICAL AND SAFE—As in all Moore Positioners, the pilot is easily removed for cleaning and the pilot spring operates in the same direction as the air supply

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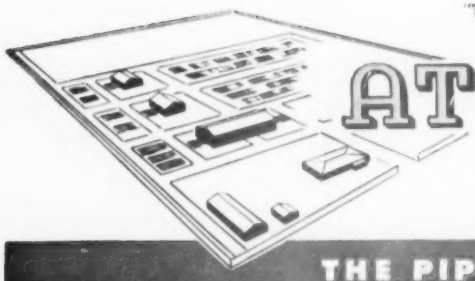
Aerial view Houston Plant

Ten skilled inspectors check every operation. Each has memorized the API Manual pertaining to his duties. Gauges are regularly calibrated. We are proud to show visitors through our plant. Call us when you are in Houston.

"THE SOUTH'S MOST MODERN PLANT FOR FINISHING STEEL TUBULAR GOODS"



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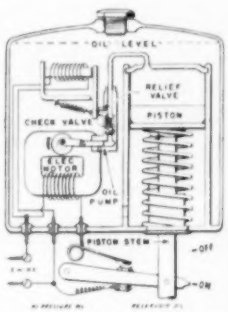
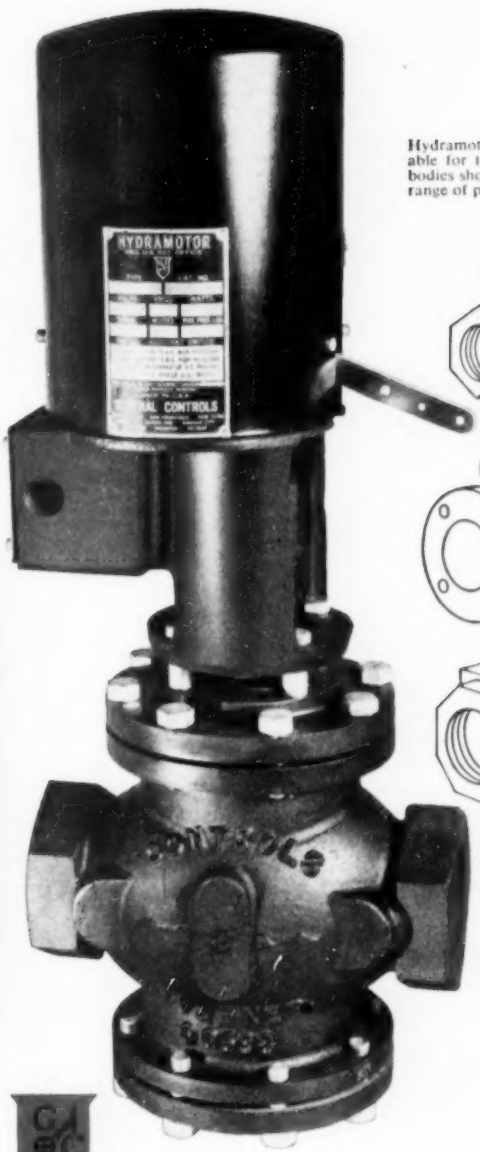
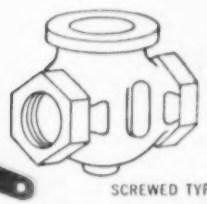
Featuring two-wire, positive, automatic shut-off in case of current failure, General Controls' Hydramotor* Valves perform dependably under all kinds of pressure, temperature and flow conditions. Lifetime-sealed in oil against dust, grit and weather, the Hydramotor operating mechanism applies electro-hydraulic power direct to the valve, thus eliminating the need for a complicated gear train. With only three moving parts, General Controls' Hydramotor* Valves require no lubrication or maintenance. For safe, economical, all-weather control of gases, oils, steam and heavy viscous liquids, the *best* valve is a General Controls Hydramotor.*



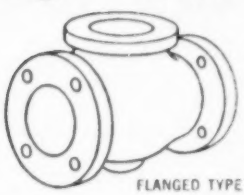
There are no gears in the Hydramotor* operator mechanism. A motor-driven hydraulic pump actuates a piston in a control cylinder, moving the main valve with maximum mechanical efficiency. Valve will handle line pressure up to 3000 psi.



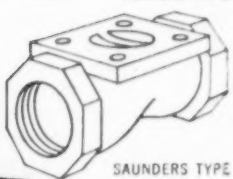
Hydramotor operators are available for the basic types of valve bodies shown below with complete range of pipe sizes from ⅜" to 6"



SCREWED TYPE



FLANGED TYPE



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General Controls

G series

Hydramotor Valves

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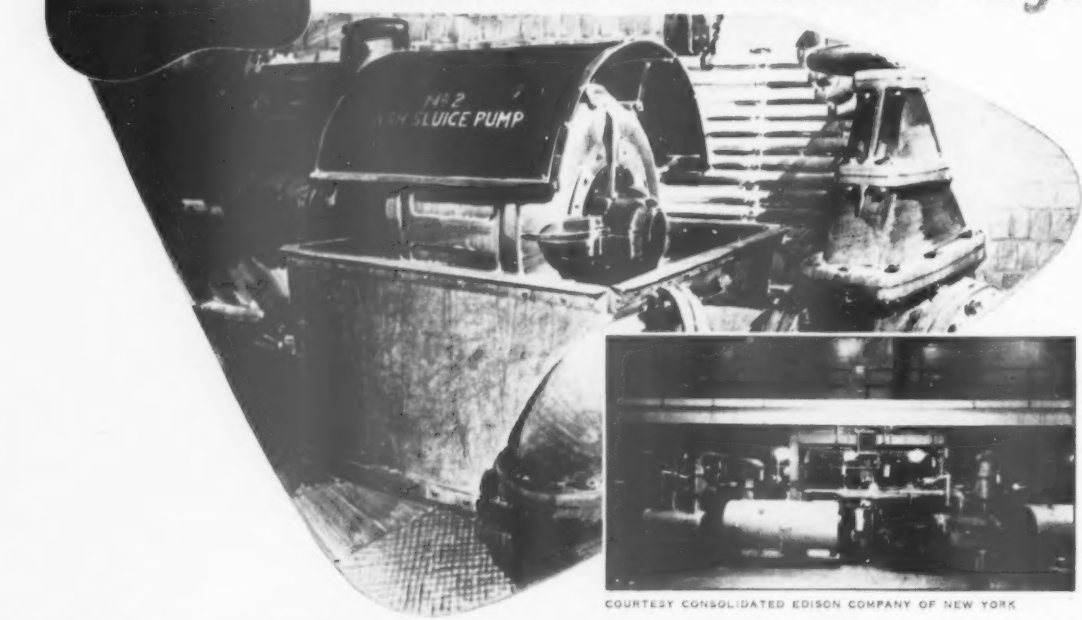
SILICONES

make motors last longer



COURTESY CONSOLIDATED EDISON COMPANY OF NEW YORK

World's Largest Utility Specifies Class H Insulation for Reliability

When millions of customers depend on you for 24 hour a day service, you can't take chances with your equipment. That's why the Consolidated Edison Company of New York took immediate action when a 350-hp Class A insulated sluice pump motor failed 3 times in one year.

Although repeated overloading was the primary cause of failure, ambient temperatures were kept high by an enclosure built around the motor for flood protection. Failure rate was cut to once a year by rewinding with Class B insulation. The motor was then rebuilt with Class H (silicone) insulation. That was 9 years ago, and it is still in service.

That was Consolidated Edison's first experience with Class H. Since then, many other motors have been rewound with Class H to withstand tough operating conditions. Over 79% or 71,700 out of a total of 90,500 horsepower in new motors bought for major auxiliary installations have been Class H insulated.

Consolidated Edison has also pioneered the use of Class H insulation in sealed dry-type unit substation transformers. They estimate that the cost of such units is more than competitive with conventional installations for power plant auxiliary supply. Convenient and safe, the Class H transformers can be located almost anywhere. And the cost of cable, switchgear, fire protection and related equipment is greatly reduced. That's why Consolidated Edison has already bought eighty-one 1250 KVA Class H transformers for unit substation work, and twelve 1000 KVA units for miscellaneous light and power.

No wonder engineers and management men throughout industry now specify Class H insulation made with Dow Corning Silicones to get as much as 50% more overload capacity or 10 times the life of electrical equipment built with the next best class of insulation.

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- ☐ Data on Silicone Grease for motor bearings
- ☐ 32-page booklet entitled "What's A Silicone?"

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MANY OF THE PEOPLE in this picture are stockholders as well as employees at Standard Oil's Whiting refinery. Outright bonuses of company stock are given to employees who invest in United States Savings Bonds under our employee savings and stock bonus plan. As both employees and owners, they have a double interest in serving you.

31,000 OF OUR EMPLOYEES OWN STOCK IN THE COMPANY

THIS is an unusual street. Probably half the people who walk here are stockholders. That's a good average—even for big city financial districts.

This is a main street within Standard Oil's refinery grounds at Whiting, Indiana.

Employee ownership of stock has been a tradition at Standard Oil, both through individual purchase and employee plans. Today about 31,000 of the more than 51,000 employees of Standard Oil and its subsidiary companies are share owners.

They are members of a stockholder family of almost 125,000. These owners include individuals from almost every walk of life, as well as many institutions, such as charitable organizations, colleges, banks and insurance companies.

Here is a part of what our employees and investors have shared in creating:

A company that produces more than 2,000 useful petroleum products which are sold at surprisingly low prices.

A company whose employees enjoy wages and benefits well above the national average for industry generally.

A company that buys goods and services from more than 32,000 other companies employing hundreds of thousands of men and women.

A company that has invested more than $565,000,000 since 1945 in developing new oil fields and drilling wells, thus helping to build up the nation's petroleum reserves.

We thought you'd be interested in these facts about a free, competitive enterprise—how employees with their work and investors with their capital have teamed up to build a strong link in an industry that serves America so well.

Standard Oil Company

(INDIANA)

. . . another place where REPUBLIC

ELECTRUNITE PRESSURE TUBES

DO THE JOB BEST . . .

When you take heat exchangers off-stream for retubing, make sure you increase the time between retubings . . . install Republic ELECTRUNITE Pressure Tubes.

You have your choice of carbon steel tubes and several analyses of ENDURO Stainless Steel tubes . . . all made by the ELECTRUNITE process which assures uniformly round tubes inside and out, uniform wall thicknesses and uniform bending and expanding characteristics.

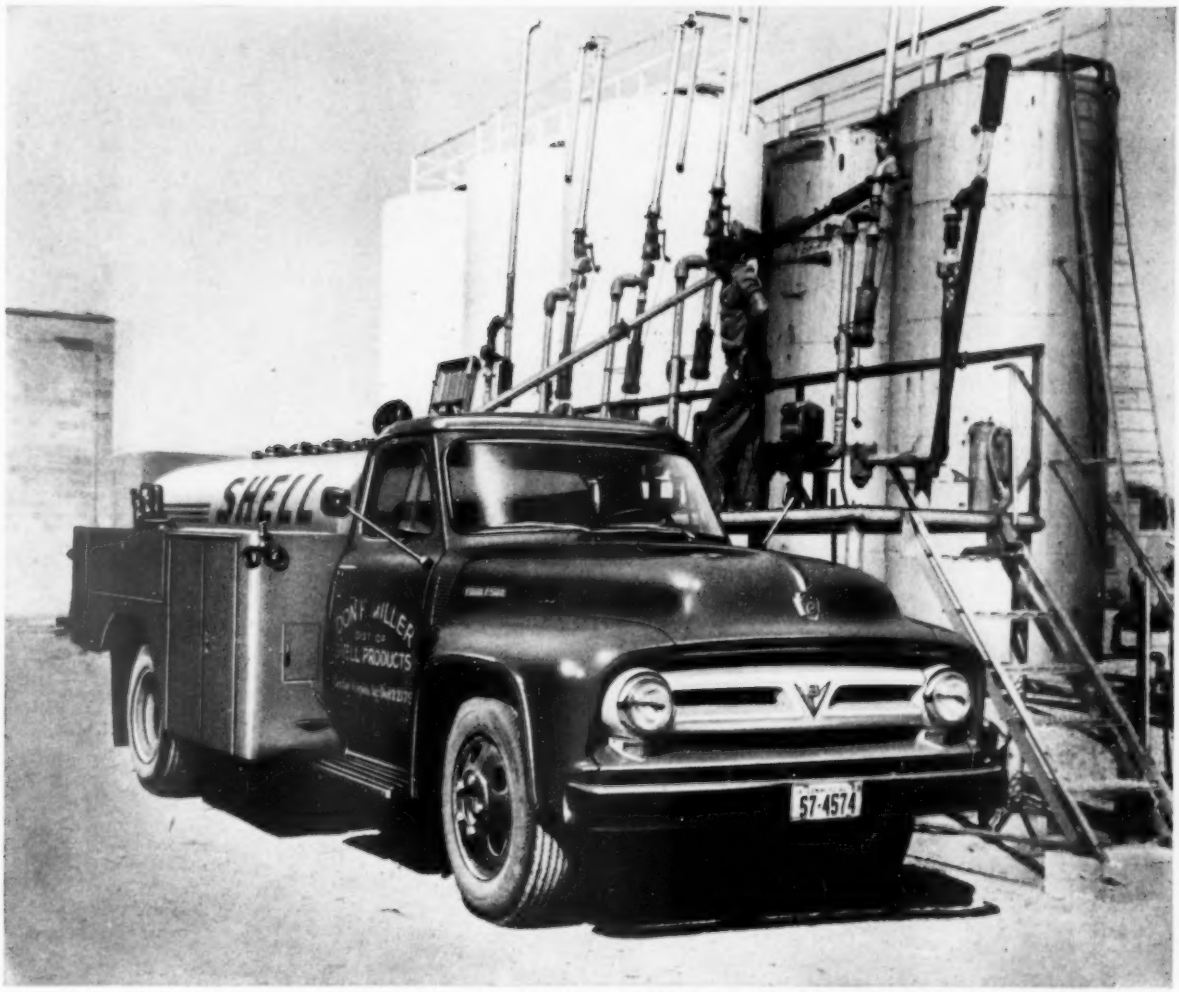
And you needn't wait until retubing to get the long-lasting benefits of Republic ELECTRUNITE Tubes . . . leading manufacturers of heat exchanger equipment know and use these time-proven tubes for many *new* condensers and heat exchangers.

Write for Booklet giving specifications and design data on Republic ELECTRUNITE Boiler, Condenser and Heat Exchanger Tubes.

STEEL AND TUBES DIVISION
REPUBLIC STEEL CORPORATION
219 EAST 131st STREET • CLEVELAND 8, OHIO

ELECTRUNITE—The Original Electric Welded Boiler Tube

Republic
REPUBLIC STEEL
ELECTRUNITE
BOILER, CONDENSER AND HEAT EXCHANGER TUBES



Popular Ford F-500—for six years the sales leader in the 1½-ton class. Wheelbases for 7½- to 13-ft. custom bodies. Choice of V-8 or Six engine.

"A real profit builder"

"Time saved is money in the bank for me. Our new, time-saving Ford Truck is a real profit builder," says Don H. Miller, Distributor of Shell Products, Cedar Rapids, Iowa. "We are now able to make one extra trip *per day!* The V-8 engine is big on performance —light on gas and oil.

"I like the Ford because it handles so easy in heavy traffic, makes fast work of maneuvering in 'tight spots.' And Ford's *Driverized* Cab sure fills the driver's bill. Visibility, room, real comfort . . . it's got 'em all!

"One reason I chose Ford is that Ford's got such a good reputation for long life that I can count on a higher price for my truck when I come to trading it in."

Ford's new F-500 is also available as a sturdy 9- or 12-ft. Platform-Stake.

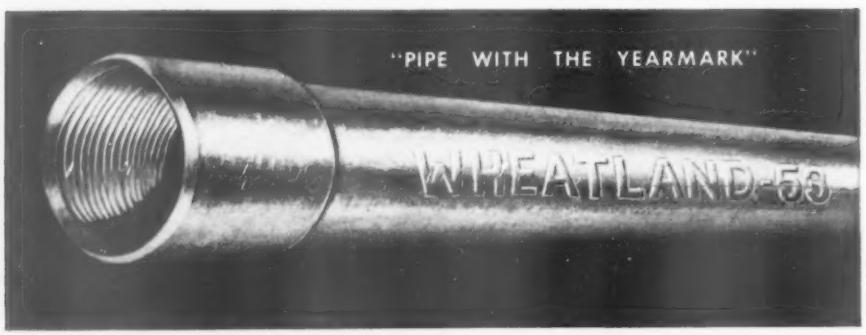
WHAT ABOUT YOU? Could Ford's popular, 1½-ton F-500 work to your advantage? For complete information, write: Ford Division, Ford Motor Co., Dept. T-20, Box 658, Dearborn, Michigan—or call your Ford Dealer, *today!*

FORD
ECONOMY
TRUCKS

SAVE TIME • SAVE MONEY • LAST LONGER

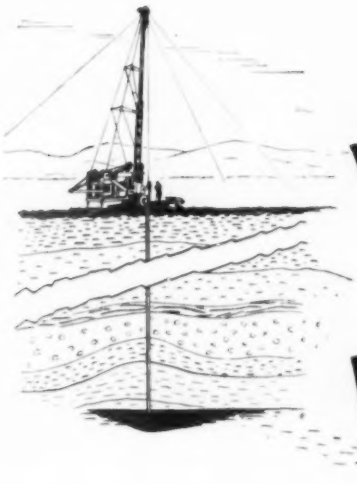
"Built-in" endurance

Nothing in nature compares with the eagle's sustained endurance in flight. For that same "built-in" strength in steel pipe, experienced specifications men depend on Wheatland—stamped with the year of its manufacture for your assurance of newest developments to produce steel pipe with "built-in" endurance.



WHEATLAND TUBE CO

BANKERS SECURITIES BUILDING, PHILADELPHIA 7, PA.



when you're in the hole.... you can count on BUCYRUS-ERIE SPUDDERS

Simplified controls — easy to reach, easy to manipulate — enable your driller to be on top of the job at all times. This means a saving in time and effort for him, a saving in money and material for you when quick action can prevent a fishing job.

BUCYRUS-ERIE COMPANY
SOUTH MILWAUKEE, WISCONSIN

Outstanding features of the easy working controls include:

1. **High and low speed levers, inter-connected to provide instantaneous speed change without stopping. Quick reverse, too, with reverse drive lever.**
2. **A sensitive and positive cam that controls engine speed.**
3. **An adjustable latch bar on the bull reel brake lever which allows automatic feeding as the drill bit cuts deeper.**

Ease of operation teams up with a string of other pace-setting Bucyrus-Erie spudder advantages. Write for complete details on the 60-L, 28-L, 36-L, 48-L.

FIRST with the Finest in Spudders

BUCYRUS ERIE

6553

QUICK SHEAVE CHANGES for maintenance of this water flooding equipment are easy when the QD is used. The hub stays put, permanently aligned and only the rim comes off when the heavy assembly bolts are used as jack screws. Re-assembly is just as easy.

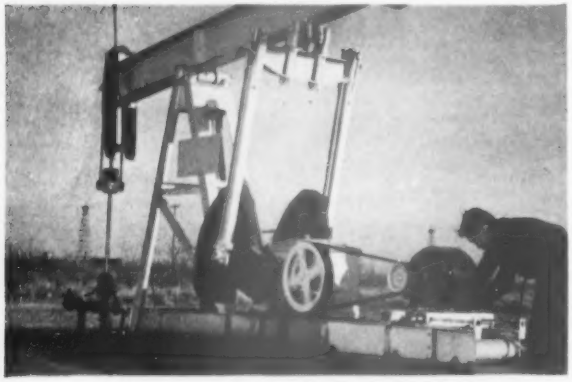
Drilling, waterflooding pumping...the efficiency of all three may depend on the sheave you choose!

Only Worthington's exclusive QD design meets every oil field requirement

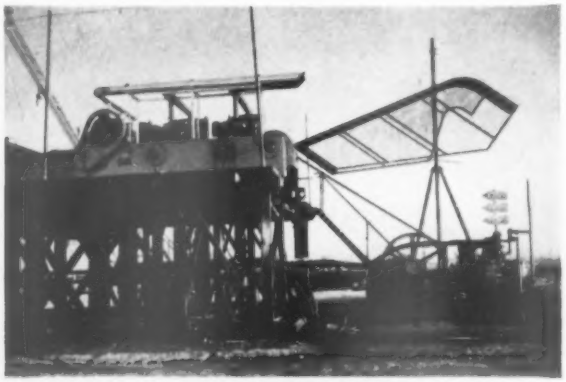
Whether it's easy maintenance, speed in assembly, or just smooth operation you're looking for, you'll get it with Worthington's QD Sheaves.

Their unique two-piece construction makes them easy to get on, easy to get off. Yet the heavy-duty taper cone friction grip hugs the shaft tight against even the heaviest shock loads.

That's why it will pay you to standardize on Worthington QD's for every oil field job. Write Worthington Corporation, Oil City, Pennsylvania.



INDIVIDUALLY DESIGNED FOR THE LOAD it has to carry, the QD sheave on this pumping job will probably outlast the equipment with which it is used. Worthington first built the famous QD to the specifications of oil production men. It's now accepted as *standard* for all kinds of duty.



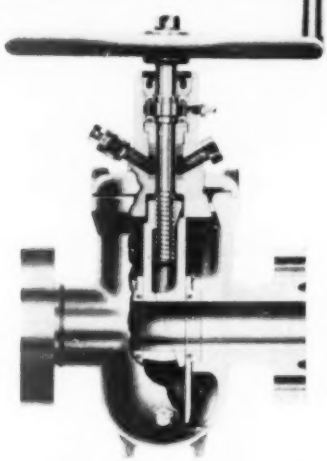
THE EXTRA GRIPPING ABILITY of the QD sheave is especially important on drilling rigs like this. Its tapered cone friction grip withstands heavy shock loads without slipping. Servicing rigs like this is easier, too, because the QD can be mounted and dismounted faster.

MV.3.7

WORTHINGTON

BUY THESE WORTHINGTON STANDARD PRODUCTS FROM YOUR LOCAL DISTRIBUTOR

Compressors • Pumps • Multi-V-Drives • Variable Speed Drives



All W-K-M Valves have a perfectly smooth bore. There are no cavities or projections to cause turbulence or to collect sediment. Gates and seats are protected against cutting or damage of any kind. These advantages are a result of the W-K-M Expanding Gate development which is explained below.

In closed position, the gate (left) and segment (right) seal tightly against both seats.

When opening or closing, the gate and segment are in neutral position permitting free upward or downward movement of the gate assembly.

When open, the gate and segment again seal tightly against both seats and the bore of each lines up perfectly with the bore of the body to provide a smooth, full-round conduit.

You can **completely** overhaul a W-K-M Valve right on the tree in one hour! When overhauled, the valve becomes as good as new, ready for many more years of efficient, trouble-free service.

There is no need to go into great detail to point out the advantages and economies of on-the-spot repair or overhaul. Frequently the time and money saved will amount to much more than the cost of the valve.

Long run performance is far more important than first cost. When you buy, specify W-K-M and you'll be sure of satisfactory operation for the life of your tree.

W-K-M COMPANY

P. O. BOX 2117 HOUSTON 1, TEXAS

2330 E. 8TH ST., LOS ANGELES, CALIF.

EXPORT OFFICE: 30 Rockefeller Plaza, New York, N. Y.

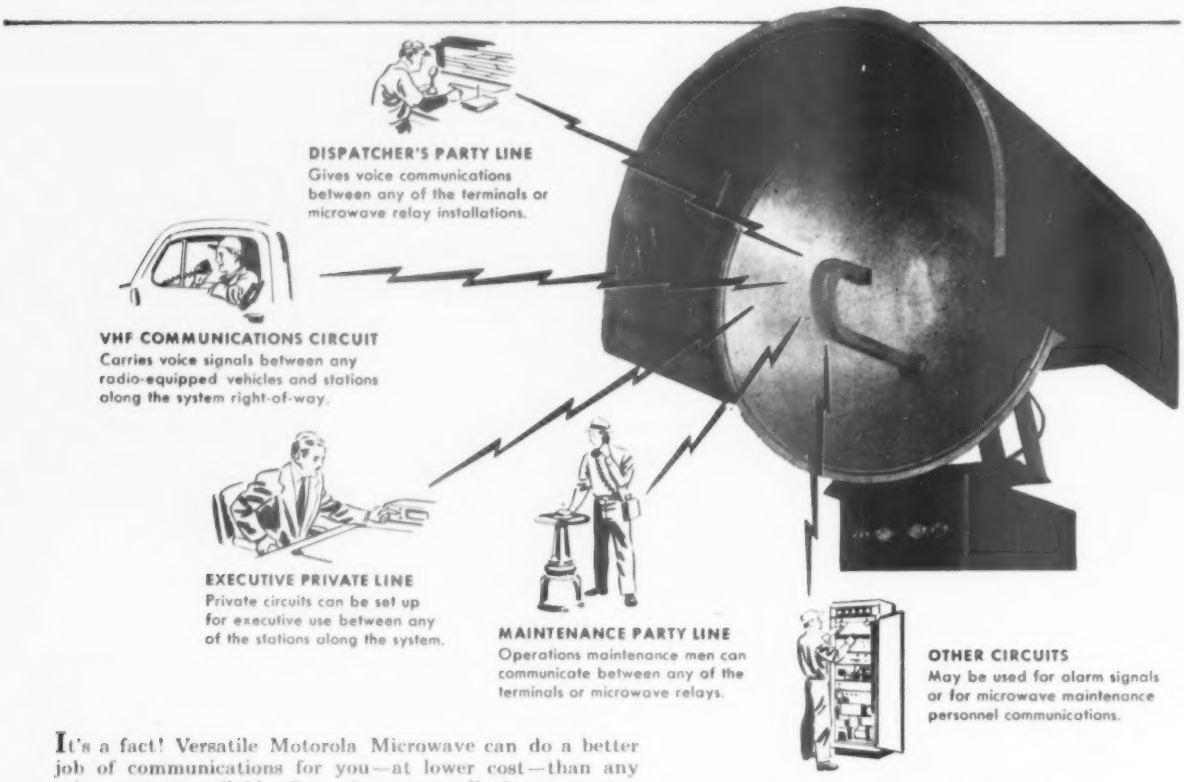
W-K-M Valves

ALL W-K-M VALVES HAVE Through-Conduit Fluid Passage • Parallel Expanding Gate Assembly

Oversize Replaceable Seats • Double Row Thrust Bearings on Stem • Internal Lubrication

Here's how Multi-Channel MOTOROLA MICROWAVE can *SPEED YOUR OPERATIONS!*

Dependable 24 hour a day communications cuts costs, saves man hours!



DISPATCHER'S PARTY LINE
Gives voice communications between any of the terminals or microwave relay installations.

VHF COMMUNICATIONS CIRCUIT
Carries voice signals between any radio-equipped vehicles and stations along the system right-of-way.

EXECUTIVE PRIVATE LINE
Private circuits can be set up for executive use between any of the stations along the system.

MAINTENANCE PARTY LINE
Operations maintenance men can communicate between any of the terminals or microwave relays.

OTHER CIRCUITS
May be used for alarm signals or for microwave maintenance personnel communications.

It's a fact! Versatile Motorola Microwave can do a better job of communications for you—at lower cost—than any other system available. One microwave radio frequency carrier simultaneously transmits numerous voice, telemetering, teleprinting and industrial control signals. The illustration shows how job-proven Motorola Microwave delivers positive, fail-safe control of widely separated, remote system facilities —24 hours a day!

Motorola custom-tailored systems provide non-stop communications for industry across the nation. Microwave and VHF radio tie-ins blanket plant areas, railroads, pipelines, entire cities. Discover *now* how you can cut costs and speed operations with Motorola Microwave.

For full details, write Dept. 2286-OG today!

national **Motorola**® RADIO COMMUNICATIONS service

Motorola Communications & Electronics, Inc.
A SUBSIDIARY OF MOTOROLA, INC.
900 N. Kilbourn Ave., Chicago 51, Illinois • Rogers Majestic Electronics Ltd., Toronto, Canada

MOTOROLA SYSTEMS ARE IN AND WORKING FOR THESE COMPANIES

Below is a partial list of systems installed and operating, and those under construction(*).

Pacific Power and Light Co., Portland, Ore.
Brazos River Electric Transmission Cooperative, Waco, Tex.
Illinois Power Co., Decatur, Ill.
Central Illinois Public Service Co., Springfield, Ill.
Pan American Pipeline Co., Houston, Tex.
Shell Pipeline Co., Houston, Tex.
Panhandle Eastern Pipeline Co., Kansas City, Kans.
Southern Counties Gas Co., Los Angeles, Calif.
La Fourche Telephone Co., Golden Meadow, La.
Mid-Valley Pipeline Co., Longview, Tex.
Greenwood Telephone Co., Greenwood, S. C.
*Bonneville Power Administration, Chehalis, Wash.
*Sinclair Pipeline Co., Independence, Kans.
Freeport Sulfur Co., New Orleans, La.
*West Coast Telephone Co., Everett, Washington
*Dayton Power & Light Co., Dayton, O.
Southern California Edison Co., Los Angeles, Calif.
*Middle South Utilities, Pine Bluff, Ark.

The trend is to MORE and MORE MOTOROLA MICROWAVE!

WHEN ANSWERING THIS ADVERTISEMENT, PLEASE MENTION "ITEM 5367"

background photo courtesy of Shell Oil Company

J-M CHEMPAC®—an asbestos-Teflon packing that withstands virtually ALL chemicals

THIS NEW Johns-Manville development combines the sealing action and heat-resistant characteristics of asbestos with the all-around chemical resistance of Teflon. Its base is strong, resilient asbestos fibers thoroughly impregnated with chemically inert Teflon.

The versatility of Chempac greatly reduces the number of packing styles needed for chemical equipment. Stocking presents no problem because its inert ingredients do not deteriorate.

Chempac can be recommended for packing pump rods or shafts, valve stems, agitator shafts, expansion joints, rotary filters and similar apparatus. It is outstanding in service against many acids, alkalies, caustic solutions, and solvents, at temperatures to 525° F.

Chempac Packing is available in coil, spiral and ring form for rod, plunger and valve stem service. Style Nos. 2011, 2012 and 2013 are made of white Canadian Chrysotile Asbestos. No. 2014 is made of blue African Crocidolite Asbestos. Johns-Manville also makes Chempac Gaskets, Nos. 117 and 138 of plies of asbestos cloth treated with Teflon.

Your Johns-Manville Packing Distributor can help you select the right Chempac Packing or Gasket for your application. For complete information write him or Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

JOHNS MANVILLE JM PRODUCTS

Johns-Manville PACKINGS & GASKETS

Down

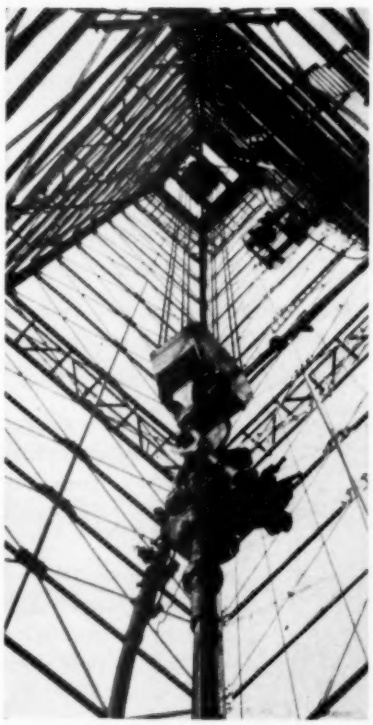
11,000 feet with Tiger Brand Wire Lines

WHEN these pictures were taken, Kelly Drilling Co., of Houma, La., was drilling at more than 11,000 ft. on the Atchafalaya River. They had gone all the way with Tiger Brand 1⅜" 6x19 Seale Monitor Improved Plow Steel Excellay Drilling Line, with independent wire rope core.

This line is specially designed for tough rotary drilling jobs. It is made of Monitor Steel—the strongest, toughest, most wear resistant of the standard grades of steel used for wire rope. Excellay preforming reduces the tendency of the line to whip or kink, increases fatigue resistance, and assures smooth spooling. The independent wire rope core gives this line extra strength and resistance to crushing.

Specify Tiger Brand Excellay Preformed Monitor Wire Lines for *your* rigs. They assure you plenty of good service and easy handling. They come in all sizes, for all types of rigs, with either a fiber core or independent wire rope core.

If you have any question about wire line, get in touch immediately with an American Wire Rope Representative. Just call your distributor.



The derrick on this big barge rig rises 194 ft. above the surface of Atchafalaya River in Louisiana. Tiger Brand 6 x 19 Rotary Drilling Line is giving good service on this tough drilling job.

AMERICAN STEEL & WIRE DIVISION
UNITED STATES STEEL CORPORATION, GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO • UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS

U·S·S AMERICAN TIGER BRAND WIRE ROPE

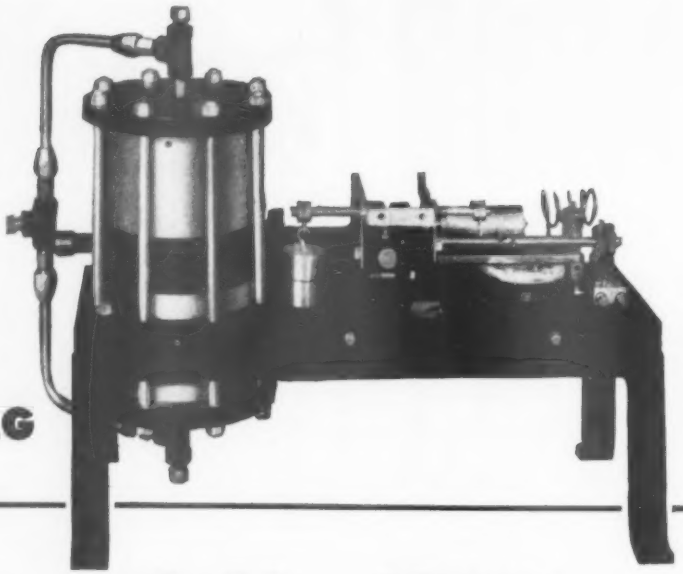
Excellay Preformed

UNITED STATES STEEL

MEASURES DENSITY

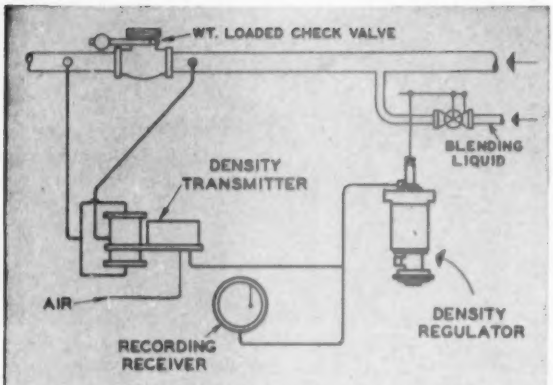
of flowing liquids

with **MINIMUM LAG**



Republic DENSITY TRANSMITTER

- **Makes a Continuous Density Measurement at Line Pressures to 300 psig.**
- **Transmits Air Loading Pressure Proportional to Flow Density to Remote Reading Instruments and Control Devices.**



Here's How Transmitter is Used to Control Blending of Lubricating Oil

Continuous measurement of flow assures prompt detection of density changes . . . permits corrections while liquid is still in flow line. There's no intermittent sampling to cause errors or lags.

Transmitter is all metal; contains no glass tubing to limit its application to very low pressures. For corrosion resistance, transmitter can be furnished in a wide variety of metals including nickel.

Narrow range spreads as small as 0.05 equivalent specific gravity for extreme accuracy of measurement are available. Accuracy is guaranteed to 1/2 of 1% of range spread for all ranges.

Get all the facts about this instrument. It's fully described in Data Book 1004. Write for your copy now.

REPUBLIC FLOW METERS CO.

2240 Diversey Parkway, Chicago 47, Illinois

DURABLA

METAL PUMP VALVE UNITS ARE USED ON ALL TYPES OF RECIPROCATING PUMPS IN OVER 500 APPLICATIONS

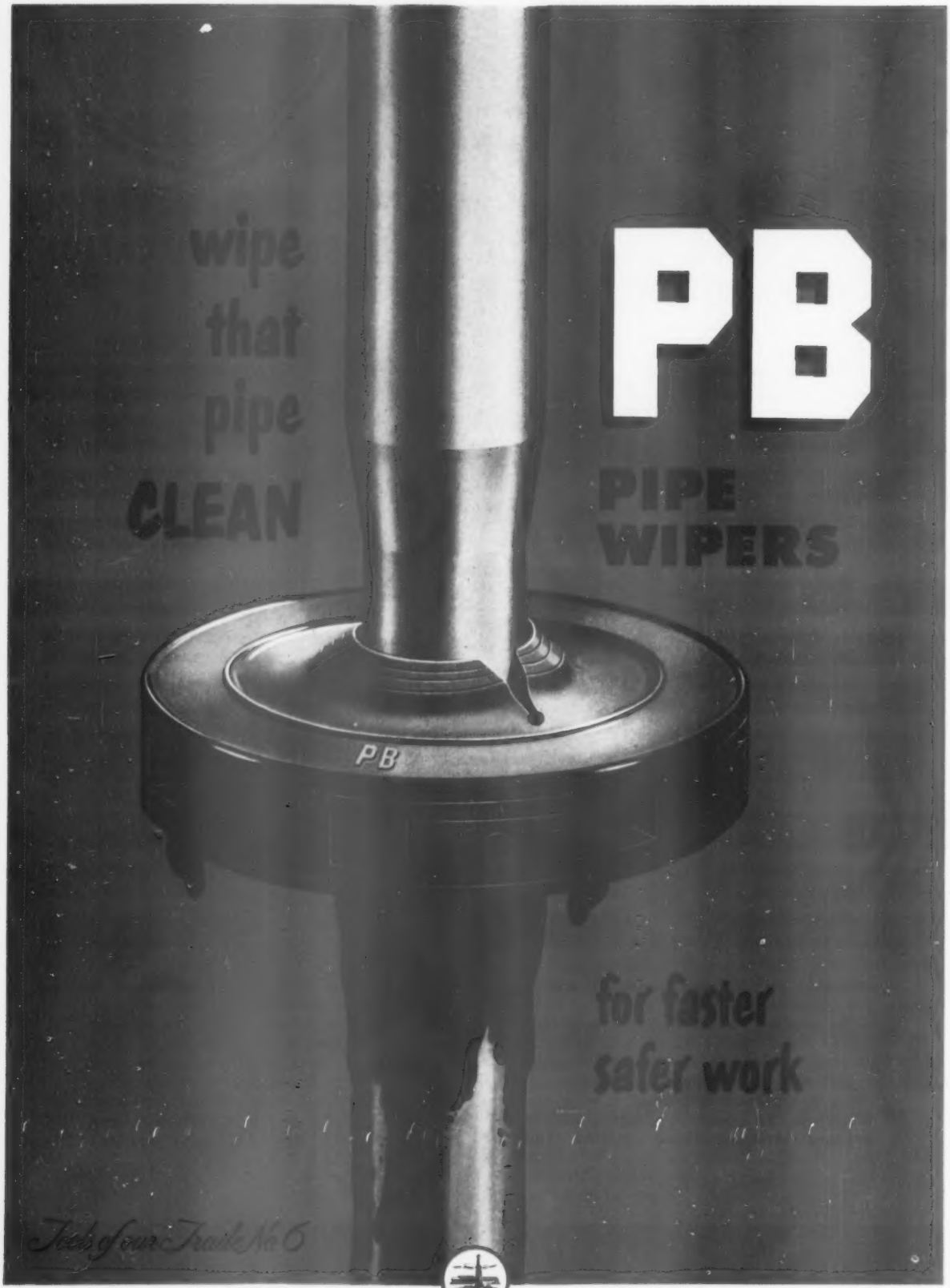
- **METALLURGICAL INDUSTRIES**
  - Mining
  - Steel Plants
  - Refineries
- **RAILROADS**
  - Shops and Roundhouses
  - Water Service
  - Locomotive Feed Water Service
- **PROCESSING INDUSTRIES**
  - Chemical Plants
  - Soap Manufacture
- **STEAM POWER PLANTS**
  - Central Stations
  - Industrial
- **CONSTRUCTION**
- **ROAD BUILDING**
- **WATER WORKS**
- **GAS PLANTS**
- **PETROLEUM INDUSTRY**
  - Oil Field Service
  - Oil Pipe Lines
  - Oil Refineries
- **MARINE**
  - Shipboard Service
  - Cargo Transfer
  - Shipyards and Drydocks
- **DIESEL POWER PLANTS**
  - Public Utility
  - Industrial

Wherever reciprocating pumps are used, and the above chart is merely an outline of some of the principal fields of application, DURABLA METAL PUMP VALVE UNITS* will be found in service, sometimes as standard equipment supplied by the pump manufacturer, sometimes as replacement units on a wide variety of pumps. To assist in ordering and stock keeping there are eleven standard sizes of DURABLA Pump Valve Units, designed to meet over 300 variations in installation requirements. In virtually every conceivable pump application; under extremes of high or low temperature; with highly corrosive fluids; in any position; and in service where long-term freedom from routine inspection and replacement is necessary, DURABLA Pump Valve Units are available to meet your needs.

Write DURABLA Engineering Department for information and Bulletin, Reference OG11

* Patent Numbers 2090486, 2117504

DURABLA MANUFACTURING COMPANY
114 LIBERTY ST. NEW YORK
BRANCHES IN PRINCIPAL CITIES. FOR CANADA REFER: CANADIAN DURABLA LIMITED, TORONTO

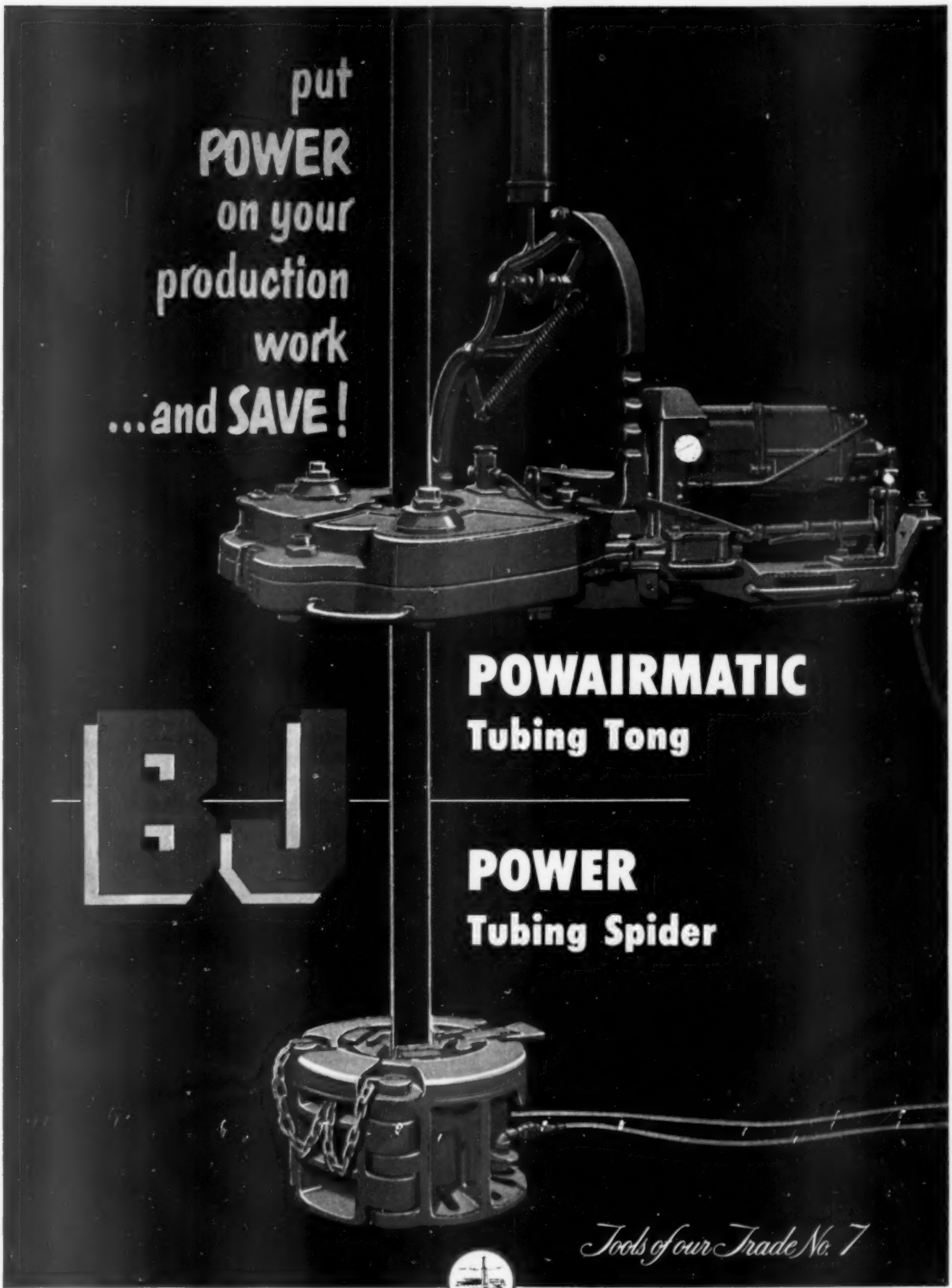


PB *OIL FIELD RUBBER SPECIALTIES*

BJ PB

Byron Jackson Co. *Since 1872*

LOS ANGELES NEW YORK FORT WORTH HOUSTON



BJ MEANS ENGINEERED OIL TOOLS

BJ PB

Byron Jackson Co. Since 1872

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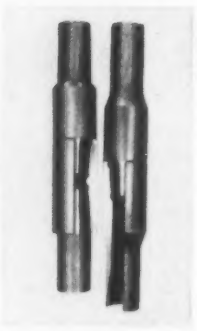
SHEFFIELD

Alloy Steel



Produced In A Full Range Of AISI Grades To Meet Virtually All Manufacturing Requirements

Tonnage-wise, Sheffield's steel producing capacity has been stepped up many times.

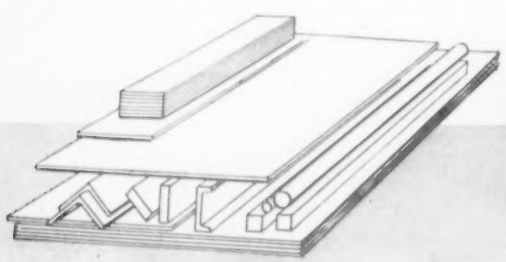
So has the range of grades in which Sheffield steels are made. These include the full range of standard AISI alloy steels. It is estimated that these meet up to 95% of requirements of manufacturers in the heavy hard goods field.

New annealing and heat treating facilities further widen the levels of strength, or hardness in which Sheffield alloy steels are supplied. Also the range of shapes and sizes is constantly being broadened for more varied engineering application.

In order to insure that their chemical and physical ranges fall within close limits, Sheffield alloys are electronically checked with a direct reading quantometer. It is capable of simultaneously determining the quantities of eight different alloy elements in a matter of minutes.

Pictured above are some of the products which manufacturers make from Sheffield alloy steel. Sheffield offers to all manufacturers, engineering and research organizations the services of its metallurgical and engineering staff in developing steels to fit individual and particular requirements.

Write or call your nearest mill or district sales office if you have steel problems involving strength, hardness and corrosion or abrasive resistance which alloys impart.



SHEFFIELD

STEEL

CORPORATION

HOUSTON KANSAS CITY

TULSA

SUBSIDIARY OF ARMCO STEEL CORPORATION

R-S valvEvents

• EXCERPTS FROM THE R-S BOOK OF EXPERIENCE •

Simplified Control and Shut-off of Volume and Pressure

The underground application shows a 50-pound R-S Valve with gear reducer, lubricating lines and operating nut which is hand operated with a wrench. Only a few turns of the wrench are required to open or close the valve.

Practically every R-S Valve installation, particularly when automatically controlled, provides useful experience that can be applied in other industries although they may be far apart in classification. It is this accumulation of engineering experience coupled with unexcelled production facilities that can be so helpful to you.

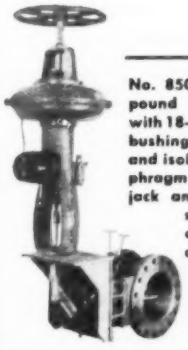
Call the R-S representative at the inception of your application. Benefit by his research and engineering experience in the simplified control and shut-off of volume and pressure.

S. MORGAN SMITH Company • YORK, PA.

MANUFACTURERS OF

HYDRAULIC TURBINES-VALVES

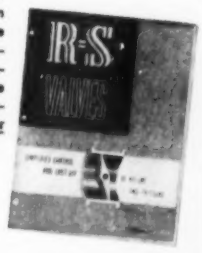
REPRESENTATIVES IN PRINCIPAL CITIES

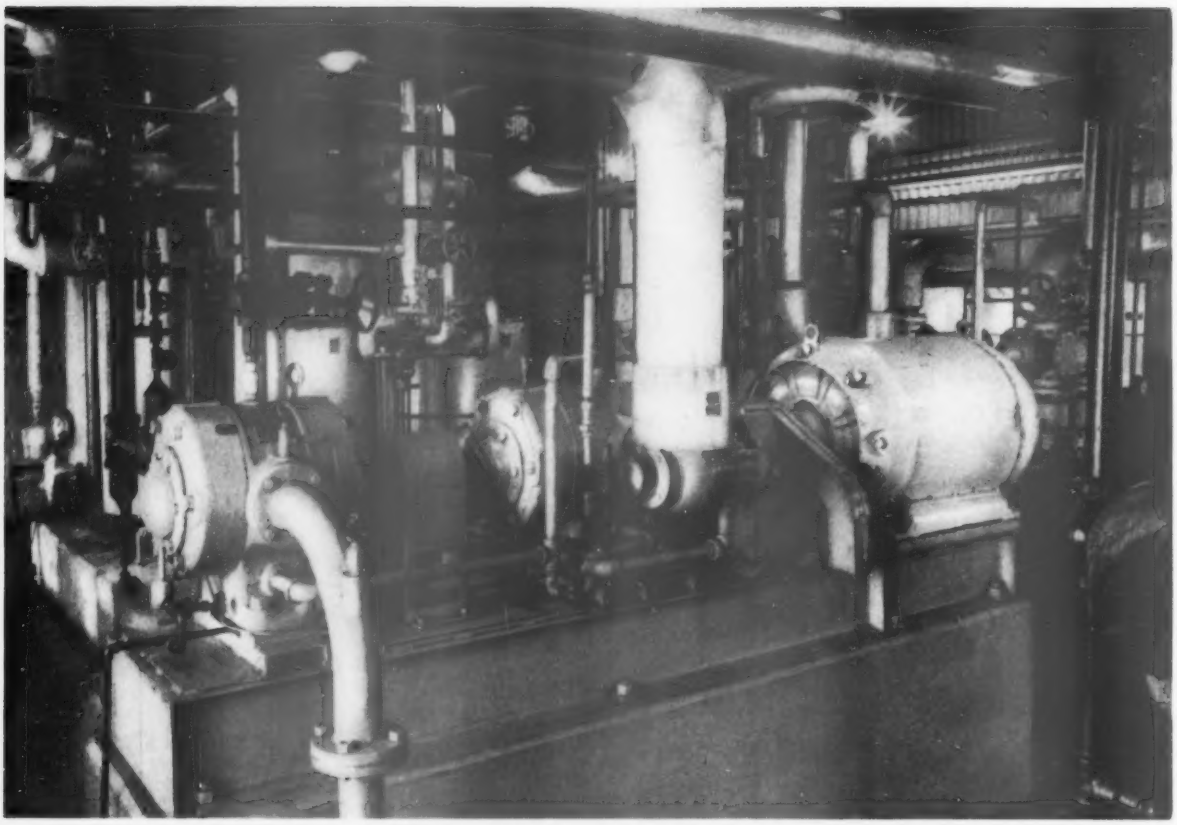


No. 850—Ten-inch, 300-pound valve equipped with 18-8 shafts, hastelloy bushings, stick lubricators and isolating valves, diaphragm top with hand-jack and positioner. Installed for the flow control of sour crude petroleum.

No. 801—Three-inch, 125-pound bronze screwed end valve with handlever control and locking device. There is a size and type of R-S Valve for any industry or process.

Catalog No. 20 describes R-S Valves in detail—types, prime movers, applications and specifications. Contains more than 150 illustrations. Write for your copy.





Fuller Rotary C70-70H Two-stage Compressor, 870 r.p.m., rated 340 c.f.m. compressing from atmosphere to 70-lb. gauge, supplying air for plant services.

another

Fuller ROTARY COMPRESSOR INSTALLATION

at CONTINENTAL OIL

Those who know Fuller Rotaries for gas gathering and boosting services, specify Fullers for other compressor applications.

At Continental Oil Company, Billings, Montana, Fuller Rotary Compressors are supplying pulsation-free air for plant services. Fuller Rotary Compressors serve in every industry where reliable, economical, low maintenance operation is important in capacities to 3300 c.f.m., and pressures to 125-lb. per sq. in. Write today for complete information. Fuller Company, Catasauqua, Pennsylvania.

Fuller

high-efficiency, vane-type rotary compressors for gas gathering, gas boosting, repressuring flare gas, refrigeration, engine starting, pneumatic power, pneumatic controls, general plant air, air lifts, and vacuum service.

C-241
2250

A multicylinder gas engine, properly designed, can operate 24 hours a day, month after month, without stopping—10 years without overhaul. Such is the performance of MM Oil Field Engines.

These engines have been specially designed for this job. Superior methods of filtration cleanse the air, fuel, lube oil and crankcase vapors. Exclusive MM water jacketed base pan with filter cartridge mounted inside, maintaining a 190° constant lube oil temperature, eliminates sludge formation which in ordinary engines combines with dirt and grit to destroy moving parts. Heavy fine grain engine castings easily take severe shocks and strains imposed by oilfield loadings.

Thousands of these engines are operating for satisfied customers in oilfields throughout the world.

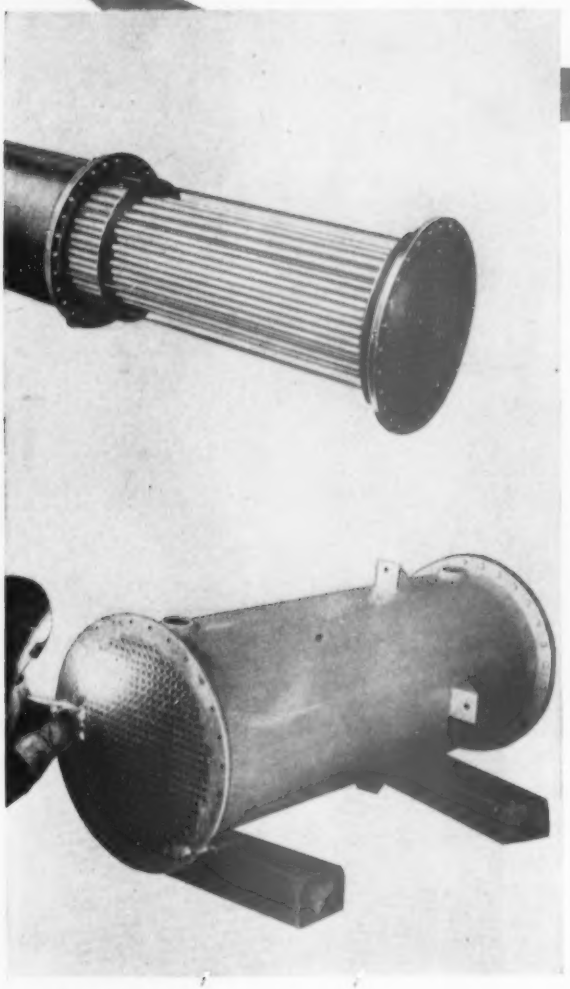
MINNEAPOLIS-MOLINE distributed by **SHRIMPTON** MANUFACTURING AND SUPPLY CO.

MINNEAPOLIS 1, MINNESOTA

Canadian Distributor: Disher—Winslow (Alberta) Ltd., Edmonton, Alta.

LOS ANGELES • OKLAHOMA CITY • KILGORE

When Down-Time's Got You Down
Get Exchangers Back on the Line Faster
...with *Carpenter* Stainless Tubing



Heat exchangers last longer when they are tubed with Carpenter stainless—but eventually, after years of operation, continuous or intermittent, they'll need retubing and there again is where Carpenter delivers an "extra".

Carpenter Stainless Tubing has the uniform wall thickness, the good ductility and the unvarying, piece-to-piece quality that make for the easiest tube fitting and rolling in you can get. The job goes smoother and faster, exchangers are back on the line quicker when you order Carpenter.

To sum it up, there's a difference in stainless tubing and Carpenter makes it. Take advantage of this profitable difference in your next retube job. Call your nearest Carpenter representative. Remember, when you call Carpenter—"One Call Does It All"—engineering and design assistance plus 26 years' experience in helping industry to solve corrosion problems.

The Carpenter Steel Company, Alloy Tube Division, Union, N.J.
Branch Offices: Atlanta Chicago Pittsburgh Houston
Newark San Francisco
Export Dept.: The Carpenter Steel Co., Port Washington, N.Y.
"CARSTEELCO"

Carpenter
STAINLESS TUBING & PIPE

Analysis · Tolerance · Finish

- guaranteed on every shipment

Friendly, personal know-how is traditional with the Republic Staff... another reason why oil men in every oil-producing area in America refer to Republic as "The Oil Bank."

Capital and Surplus $50,000,000.00
Largest in the South

REPUBLIC NATIONAL BANK OF DALLAS

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

Announcing the 2000-hp KVS

✓ MORE POWER IN LESS SPACE

The 2000 hp KVS is very compact, requiring only a minimum of floor space per horsepower.

✓ LOWER FUEL CONSUMPTION

7600 btu per bhp at full load, 8000 at ¾ load and 9000 at half load.

✓ COOLER RUNNING

Effective scavenging keeps average temperature of pistons, cylinders and valves extremely low — saves wear, lengthens life of parts.

✓ LOW HEAT REJECTION

Total heat rejected at full load is only 2300 btu per bhp per hour from jackets of power cylinders, exhaust manifolds and exhaust turbines. Only 200 btu per bhp per hour is rejected to the oil cooler.

✓ NO AIR COOLING

Low blower pressure of 4 psi, and compression ratio of 6:1 eliminate the need for any precooling or aftercooling of the air.

✓ ECONOMICAL COOLING SYSTEM

The high temperature level recommended for the cooling water and lubricating oil, in line with four-cycle engine practice, radically reduces the cost of cooling.

✓ EASY STARTING

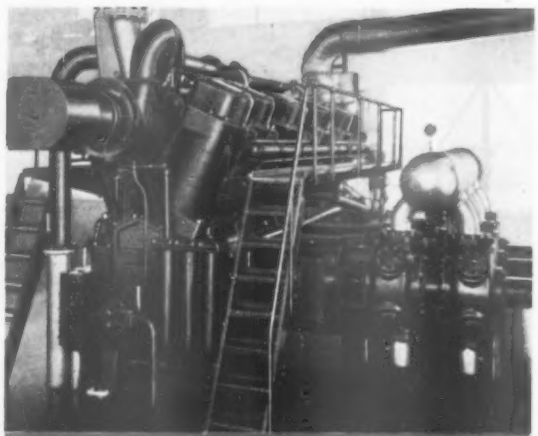
The air blowers are not needed for starting and require no external drive. Blower speed automatically increases with engine speed and load.

✓ FOUR COMPRESSION CYLINDERS

The use of 4 cylinders, all on one side, makes the KVS more adaptable to varying requirements—easier to inspect and service.

✓ ULTRA CONSERVATIVE RATING

Compression pressure of 225 lb and maximum pressure of 600 lb at 2000 bhp result in a B.M.E.P. rating of only 121.6. This conservative rating permits the KVS to handle emergency overloads with ease and safety.



Here's the first installation of a Turbocharged gas-engine-driven compressor. This Ingersoll-Rand KVS unit went on stream early in 1952. Its performance has lived up to every expectation.

The *FIRST* TURBOCHARGED Gas-Engine-Driven Compressor

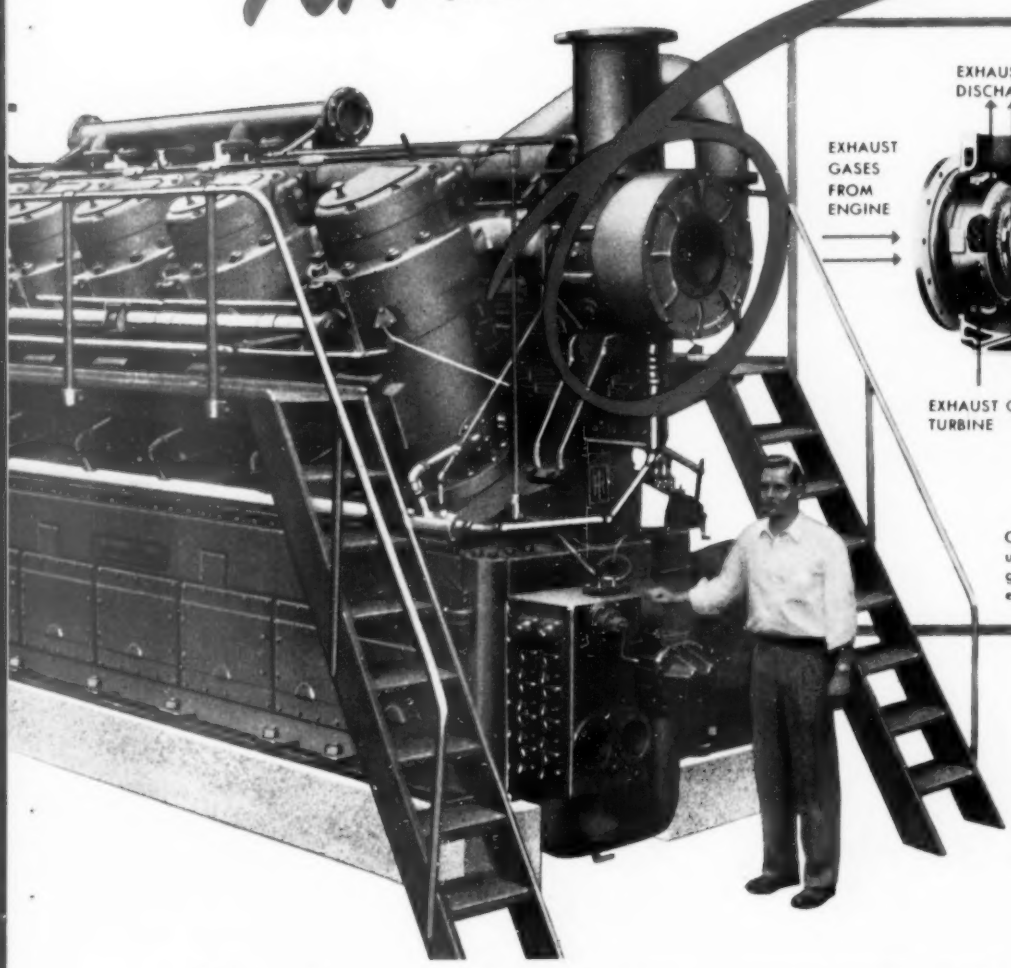
...developed through TEN YEARS of experimentation on FOUR full-sized engines

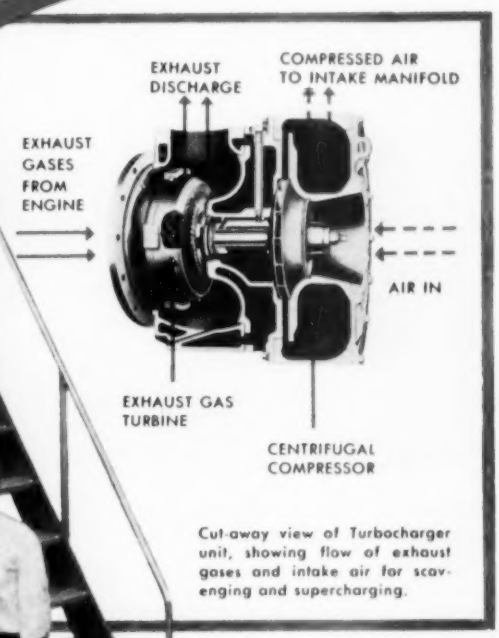
...shop and field tested for THREE YEARS

...service proved for more than a year

...now available in a regular production unit, the 2000-hp KVS

FOUR-CYCLE
gas-engine-driven compressor
IT'S TURBOCHARGED





Cut-away view of Turbocharger unit, showing flow of exhaust gases and intake air for scavenging and supercharging.

In the new TURBOCHARGED "KVS" engine, waste energy from the exhaust provides power for scavenging and supercharging, through two gas-turbine-driven centrifugal blowers, one at each end of the machine. The result—a new high in efficiency and economy! Savings in space, weight, fuel and cooling equipment make this an important advance in the design of Ingersoll-Rand's traditionally dependable V-angle, 4-cycle gas engine. Ask your I-R representative for the complete story.

4 CYCLE

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

990-6

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • DIESEL AND GAS ENGINES

For Safety, Speed and

DEPENDABLE PERFORMANCE

. . . You Can't Beat

RATIGAN

Pulling Tools

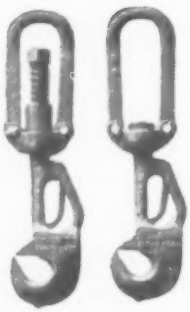
Ratigan Pulling Tools are fast *and easy to operate.* They are designed with special emphasis on operator safety with the result that accidents are held to minimum in today's higher speed operation. Insist on Ratigan Pulling Tools . . . Sold through Leading Supply Stores Everywhere.

All Ratigan Products Are Illustrated and Described in The Composite Catalog.

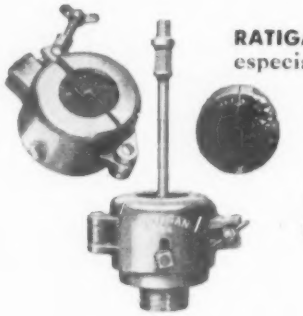
RATIGAN NO. 14 TRIANGLE "C" LINK is made in three sizes with capacities which range from 60,000 to 150,000 pounds . . . safe and efficient.

RATIGAN NO. 60-H SNAP-TYPE ROD WRENCH with round handle is made in sizes to fit any sucker rod or sucker rod coupling. There's no lost motion with this safe, quick-acting tool.

RATIGAN NO. 89 SPRING SWIVEL TUBING LINK with weight. It has a capacity of 150,000 pounds and the end links can be opened or closed instantly by means of the quick-acting safety pins.



RATIGAN NO. 91 SPRING TYPE SUCKER ROD HOOKS have a capacity of 90,000 pounds and are available with or without spring and with either long, medium or short bail. Hooks are designed for speed and safety . . . man working in the rig never misses putting elevator in the hook.



RATIGAN NO. 144 ROD WIPER especially suited to use with portable pulling machines. Acts as a stripper and shock absorber when pulling rods, and as a shock absorber and bell nipple when running rods.

RATIGAN NO. 214 TUBING TONG with fast, easy-to-change dies, is made in $1\frac{1}{4}$" size for Macaroni Tubing; and 2", $2\frac{1}{2}$" and 3" sizes for regular tubing.

J. P. RATIGAN, Inc.

1213 Santa Fe Avenue,
Los Angeles 21, California

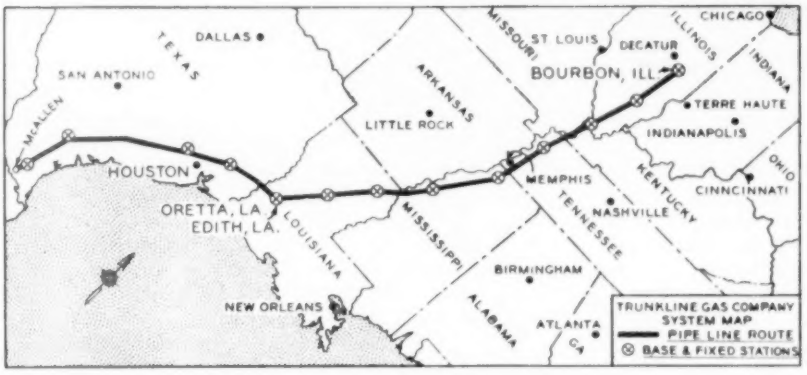
Export: National Supply Company, Inc., Export Division, 600 5th Avenue, New York 20, N. Y.

WHAT'S NEW AT BRISTOL

Bristol helps him watch 1000 miles of pipeline

THREE BRISTOL METAMETER® RECEIVERS in the Houston, Texas, office of the Trunkline Gas Company, show the static and differential pressure of gas at Bourbon, Illinois, over 1000 miles away, Oretta, Louisiana, and Edith, Louisiana. Readings are sent by microwave from these points to the Bristol receivers, where even the slightest variation in flow or pressure is recorded.

®Reg. U. S. Pat. Off.



STRETCHING FROM TEXAS INTO ILLINOIS, the Trunkline Gas Company line crosses Louisiana, Arkansas, Tennessee and Kentucky. Microwave stations all along the way speed pressure readings to the Metameter Telemeters at the main office in Houston. Because they wanted the finest, Trunkline Gas selected Bristol, the acknowledged leader in telemetering, to supply the necessary recording equipment.

Find out how Bristol's 60 years of instrument experience can help you, too. Write for Bulletin M-1710 to The Bristol Company, 120 Bristol Road, Waterbury, Conn.

BRISTOL

LOOK FOR OUTSTANDING NEW DEVELOPMENTS FROM BRISTOL

THE DEPENDABLE GUIDEPOST OF INDUSTRY

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

Custom made for your forging job

Another reason why you get uniform, high quality forgings with TIMKEN® forging steels!

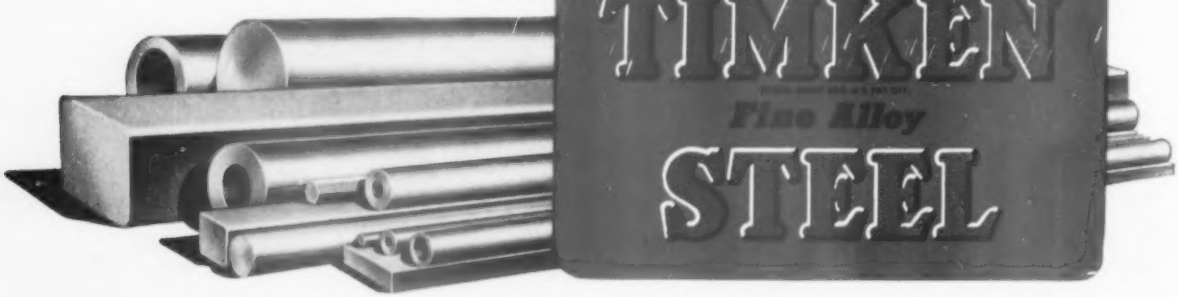
YOUR order for Timken® forging steels is handled individually in our mills. Conditioning procedure is targeted to your particular forging requirements. You get just the steel you want for uniform forgings, rejects are held to a minimum. And you save steel, because the good dimensional tolerances of Timken steel forging bars produce uniform weight multiples with minimum steel lost in flashings.

Timken forging steels give you uniform physical properties. They respond uniformly to heat treatment—from bar to bar and heat to heat. Fewer furnace adjustments are needed. And Timken forging steels have uniform grain size after heat treatment. Result: your forgings have uniformly high ductility and resistance to impact.

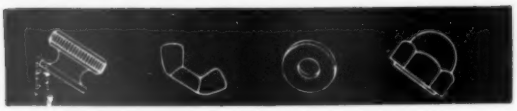
Chemical properties, too, are kept uniform in every lot of Timken forging steels by some of the most precise quality control methods known. For example, a direct-reading spectrometer—first of its kind in the steel industry—chemically analyzes a molten heat of Timken forging steel in just 40 seconds! And the melt shop has the complete analysis report within 10 minutes!

For help in improving the quality of your forgings, and cutting production costs, too, write The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH



SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS TUBING



If Corrosion is a Problem, "Fastenings by HARPER*" is the Answer*

At well or refinery, corrosion is *always* a problem—corrosion caused by sour crudes, destructive acids, salt solutions . . . even by natural weathering.

Valuable equipment should be protected by corrosion-resistant fastenings. Bolts, nuts, screws that quickly rust and corrode—washers, rivets, cotter pins that cause costly breakdowns or interrupt production, have no place in oil fields or refineries.

Harper Everlasting Fastenings prevent corrosion—protect and lengthen the life of equipment, because they are made of corrosion-resistant metals—stainless steel, Monel, nickel, silicon bronze, brass, naval bronze, copper and aluminum.

Harper is the oldest and largest exclusive producer in the field of corrosion-resistant fastenings. Over 7,000 different items are carried in stock—ready to meet your immediate needs.

Call the Harper Branch Office or Distributor in your area for stocks to fill your orders. Write the Harper metallurgical or engineering staffs on any special fastenings problems you are facing.

THE H. M. HARPER COMPANY
8208 Lehigh Avenue, Morton Grove, Illinois

HARPER

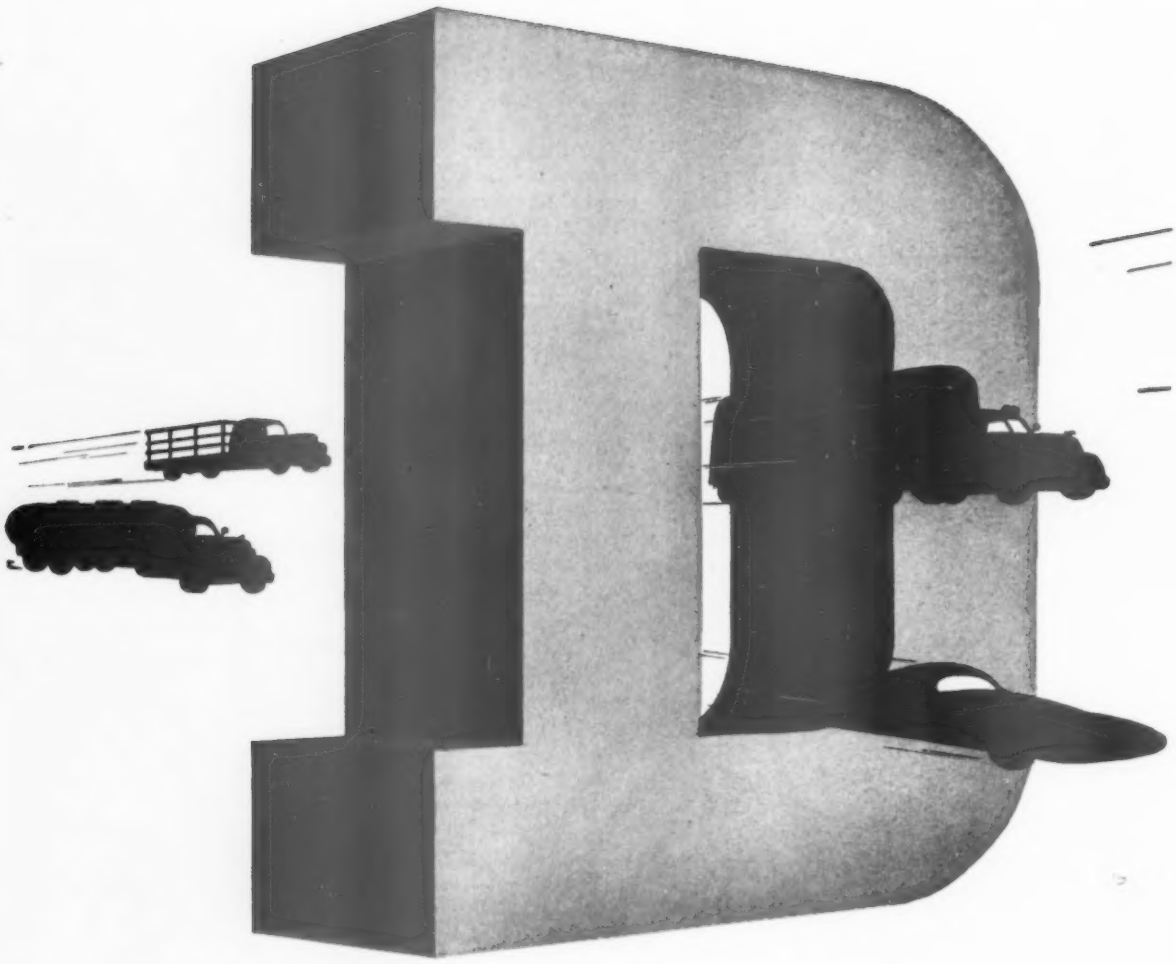
SPECIALISTS
IN ALL
NON-CORROSIVE
METALS

1¼"—7
18-8 Stainless Steel Nut

¾"—10
Castellated
Monel Nut

¾"—10 Silicon
Bronze Jam Nut

BRASS • SILICON BRONZE • NAVAL BRONZE • MONEL • ALUMINUM • STAINLESS STEEL



DAVISON DEPENDABLE CATALYSTS BUILD BETTER MOTOR FUEL

The operating efficiency of synthetic fluid-type cracking catalysts is important. This operating efficiency can be assured by uniformity of physical characteristics and chemical purity. Davison's production of microspheroidal (M-S*) is tops in uniformity . . . providing all users with a highly efficient synthetic fluid-type cracking catalyst. Your requirements can also be supplied in ground (DA-1*) form. Write for further descriptive information. Experienced Davison Field Service Engineers backed up with complete laboratory testing facilities are part of Davison's service.

*T.M.T.D.C.C.

Progress Through Chemistry

THE DAVISON CHEMICAL CORPORATION

Baltimore 3, Maryland

PRODUCERS OF: CATALYSTS, INORGANIC ACIDS, SUPERPHOSPHATES, PHOSPHATE ROCK, SILICA GELS, SILICOFLUORIDES AND FERTILIZERS

NEW! handy guide on Refinery Painting

Puzzled over painting problems? Here's a new guide that takes the guesswork out of refinery painting. In 12 easy-to-read pages, with painting recommendations in handy check chart form, it tells at a glance the right paint to use on each type of interior or exterior surface—for surfaces exposed to various temperatures and operating conditions.

Included are suggestions on surface preparation and helpful painting hints.

Ask for your copy . . . write for Brochure C-770. The Sherwin-Williams Co., Petroleum Division, Cleveland 1, Ohio.

SHERWIN-WILLIAMS
PETROLEUM FINISHES

They Say—

Imports Cut Could be Fatal

"The independent petroleum operator here in the United States would present a lot of strong arguments as to why crude petroleum imports should be controlled or cut back.

"I believe all of the arguments which he may present would prove exceedingly weak if we take into consideration the fact that our nation uses 60 per cent of the world's petroleum products but has only 30 per cent of the known petroleum reserves.

"Should friendly nations abroad be forced to sell their products behind the Iron Curtain, we would not only be playing into the hands of the Communists by supplying them with a strategic material but we would also give them the psychological advantage of a propaganda weapon which they could and would use against us to the fullest."

George E. Roper, Jr., director of world trade development for International House, New Orleans, addressing the Tulsa Chamber of Commerce.

Oil Industry Sound Financially

"The oil industry is not as susceptible to general business recessions as many other major industries.

"Since 1920 . . . our domestic demand for petroleum has declined from the previous year in only five instances, and in no case has the decline been more than 7.5 per cent.

"Our insatiable demand for more energy power transcends the questions of war or peace, or prosperity or recession, because a striving for material progress is inherent in the kind of society we have the kind of people we are."

Frank R. Markley, vice president of Sun Oil Co., speaking before the National Industrial Conference Board, New York.

Need for Depletion Allowance

"Men venture in risky drilling, largely because of the 27½ per cent depletion allowance. Remove that incentive, and our domestic supply of oil will shrivel, and we will become . . . dependent upon foreign oil within a very short time. Come war, foreign oil, of course, could be denied us.

"We cannot afford to let anything happen that would lessen the incentive to hunt for oil in the United States."

Ernest O. Thompson, chairman, Texas Railroad Commission, testifying be-

SINKER BARS — Smooth bars in 5', 10' or 20' standard lengths in 1½" or 1¾" O.D.

TUBULAR JARS — Heavy duty with forged upset stop collar. Has full 20" or 30" stroke and provides both knuckle and swivel action. 1¾" O.D., ⅞" rod.

SWIVEL JOINTS — Hollow or solid. Swivel knuckle action allows cup to center in tubing, adds life to swab cup by equalizing wear.

OVERLOAD RELIEF VALVE — Prevents stuck swabs by dumping excess fluid when swab is overloaded. Replaces regular swab valve body. Can be field adjusted to recover desired column of fluid. For 2", 2½" or 3" tubing.

ROPE SOCKETS — Plain or swivel, for all rope sizes through ¾". Top half is interchangeable on plain or swivel rope sockets and swivel rope socket joint.

For the BEST SWAB JOB use the BEST SWAB ACCESSORIES

SINKER BAR | TUBULAR JAR | HOLLOW SWIVEL JOINT | SOLID SWIVEL JOINT | SWIVEL ROPE SOCKET JOINT | OVERLOAD RELIEF VALVE | PLAIN ROPE SOCKET | SWIVEL ROPE SOCKET

Guiberson swabs are the best made ...they deserve the best accessories!

THE
GUIBERSON
CORPORATION

ESTABLISHED 1919 • DALLAS, TEXAS, U. S. A.

Sold By Leading Oil Field Supply Stores Everywhere

LOCATE STUCK PIPE
FAST AND SURE
with
HOMCO FREE POINT INDICATOR

The HOMCO Free Point Indicator serves many purposes in the oil field service. **In a single run** — the following service can be accomplished:

- Count Tool Joints
- Locate split pipe or tubing
- Determine the location of service tools in a string
- Locate Top of drill collars
- Locate lost fish in the hole
- Locate stuck point of casing, drill collars, drill pipe, or tubing
- Run in combination with string shot on same wire line trip

BACK IT OFF *with SAFETY*
with
HOMCO *STRING SHOOTING SERVICE*

(Pat. No. 2,305,261)

This method is time tested and proved to be successful — **and now** — with the use of the HOMCO Washover Back-Off Tool and the Electronic Free Point Indicator — the operator can **locate the free point, wash over, shoot the fish loose, and recover the fish and wash pipe in ONE SINGLE RUN.**

Write for detailed information or call your nearest HOMCO Service Point.

25th Anniversary

HOMCO
HOUSTON OIL FIELD MATERIAL COMPANY, INC.

P. O. BOX 2589 • HOUSTON 1, TEXAS • WO-1731

Oil Industry's Most Complete Service • Oil Field Supplies and Equipment

fore the House way and means committee, Washington.

Displaced Labor Big Problem

"In spite of the many effects which we don't know for sure, there are a few things known to be fact. We know, for example, that foreign labor, in general, is low paid in comparison with American labor.

"We know that in isolated instances we excel in technology or other advantages to a degree sufficient to offset the wage differential. But we also know that in other instances . . . we have no such superiority.

"Now the only conclusion I can draw here is that in those cases, on a free-trade basis, we should be undersold in our own markets by foreign competitors. I believe the advocates of free trade admit this a probability but they come up with a pat answer that the workers thus displaced can be absorbed by what they term 'relatively more efficient' industries.

"This is a credible theory . . . except for one fact—human beings somehow refuse to become statistics. You cannot uproot people with a bulldozer, load them on a truck and transport them to some place that suits your convenience—at least not in a free and democratic society.

"If you think displacement of labor is a small problem, ask John L. Lewis. For 10 years or more we have, pretty generally, had a surplus of coal miners in this country as a result of increasing use of oil and gas in place of coal. Ten years is quite a period of time—yet somehow those coal miners don't seem to move . . . to today we find them working 3 days a week or so as a means of spreading the work among them."

Calvin A. Campbell, vice president and general counsel, Dow Chemical Co., addressing the American Tariff League, Inc., Washington, D. C.

Unitization Proponents Strong

"It seems to us that the technological boys are far afield and operating beyond their sphere of either understanding or authority when they zealously advocate communizing private properties by law in the interest of scientific advancement. Viewed from a purely technological angle, the arguments for compulsory unitization are responsible, plausible, and convincing.

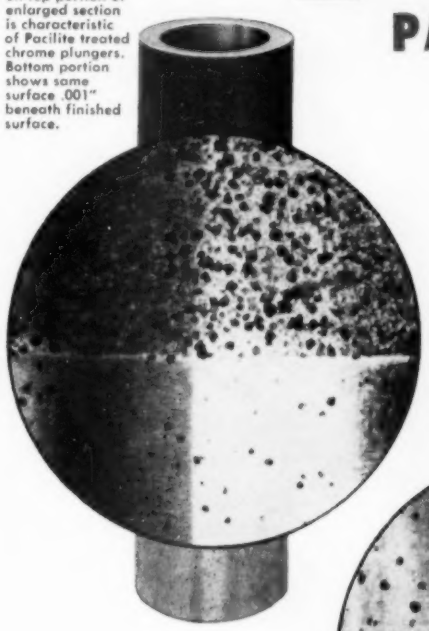
". . . The target of such propaganda is the legislature for the enactment of a compulsory unitization law, which would sound the death knell of the independent producer and send the roy-

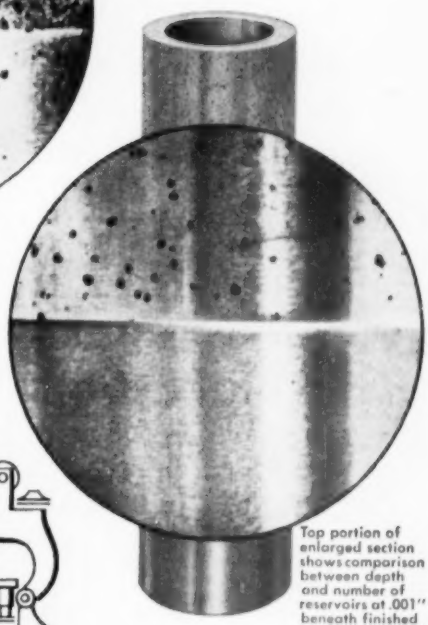
The New Pacific

PACILITE (TRADE MARK) PLUNGERS

FOR DEEP OIL WELL PUMPING...

The number of surface reservoirs on top portion of enlarged section is characteristic of Pacilite treated chrome plungers. Bottom portion shows same surface .001" beneath finished surface.

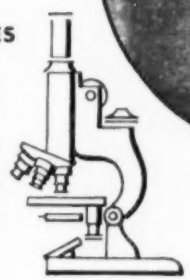




Top portion of enlarged section shows comparison between depth and number of reservoirs at .001" beneath finished surface and .005" where controlled etching has eliminated reservoirs.

HAVE MILLIONS OF MICROSCOPIC PORES

that actually soak up lubricants!



Pacific Pacilite process is a method of control etching a multitude of minute surface reservoirs to provide maximum retention of lubricants after the chrome plated plunger is ground to desired size. Result is much longer plunger life and virtual elimination of sticking and galling. Pacilite treatment also relieves high tensil plating stress and reduces possibility of cracking or shearing under heavy shock loads. For complete details write for Technical Bulletin No. 201.

PACIFIC Precision Built PUMPS

Pacific Pumps inc.

ONE OF THE DRESSER INDUSTRIES

HUNTINGTON PARK, CALIFORNIA

DW-10 *Export Office:* Chanin Bldg., 122 E. 42nd St., New York

Offices in All Principal Cities

When you think of
PUMPING UNITS
Think of
ALTEN
including IDECO types

ALL API SIZES

BOTH AT YOUR LOCAL SUPPLY STORE

BOTH MANUFACTURED BY

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Odessa, Texas
Casper, Wyoming
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alty owner back to grubbing out an existence from his bare land again.

"We have beaten like bills in the past but it has always been a hard and bitter fight. The forces backing the current move are powerful and diligently working."

From Tipro Topics, official publication of the Texas Independent Producers and Royalty Owners Association, Austin.

Louisiana Overtaking California

"Louisiana now ranks as the third largest oil-producing state. Our current output, 707,000 bbl. per day, is greatly exceeded by Texas, which can produce more than 3,000,000 bbl. per day . . . and by California, which produces about 1,000,000 bbl. per day. However, measured in the terms of barrels of production per total acres of land within state sovereignty, Louisiana is the most prolific state of all. Further, while crude-oil production in California appears to be on the decline, Louisiana's production is still on the upgrade. In 1952, we produced about 265,000,000 bbl. of oil and found almost 375,000,000 in new reserves. The proven oil reserves of Louisiana far exceed those of California."

Bruce K. Brown, president, Pam-Am Southern Corp., addressing the Purchasing Agents Association of New Orleans.

Canada to Become Big Exporter

"In 1953 Canadian wells are supplying about 45 per cent of the nation's daily requirements of 500,000 bbl.

"Before 1960 Canada expects to be, on balance, not only self-sufficient in petroleum production but perhaps able to export crude substantially to the United States."

Ole Berg, Jr., president of British American Oil Co., Ltd., addressing the National Lubricating Grease Institute, Chicago.

California Needs Conservation Laws

"California alone among the big oil-producing states has no comprehensive law to enforce efficient and progressive production methods. Until the people of California see fit to enact such a law, we are going to lose a great many barrels of oil and a great deal of gas that should be held in the ground and produced under the most favorable practices that can be developed.

"It is true that most companies in California, acting voluntarily, have done fairly well in producing oil to obtain the maximum possible recovery of un-

This GAS LIFT VALVE CAN HELP YOU IN YOUR PRODUCTION PROBLEMS

• This is the only true continuous flow, pressure charged gas lift valve (patented). It is the GOT Type "O-CF" . . . and when properly applied, it will give you lower lifting costs than you can obtain with any other type of artificial lift. Field tests show that continuous flow gas lift is the most economical way to produce many wells making even as little as 100 barrels of fluid per day; five years of service has proved the "O-CF" the most efficient continuous flow gas lift valve available. Its design and operating principle differ from all other "constant flow" valves. Controlled by a combination of tubing pressure and injection pressure, "O-CF" valves automatically establish the proper working fluid level in the well; a uniform injection pressure is permitted, full line pressure may be utilized, the valves operate efficiently against a surface choke; production is continuous, without the "slugging" characteristic of other so-called "constant flow" valves.

• Because of the intrusion of water, and other factors, many wells originally equipped with intermitting-type gas lift valves can now be produced more efficiently with "O-CF" Continuous Flow Valves. Do you have such a well? If so, ask your GOT representative to tell you the full story on true continuous flow, pressure charged "O-CF" valves.*

IF THERE IS A SHADOW OF DOUBT

• *If there is a shadow of doubt about the efficiency of your present gas lift installations, it will pay you to get the full story on all GOT gas lift valves and related equipment, including the GOT Pressure Charged Free Piston. This equipment, combined with the know-how of the GOT organization, can save money in your artificial lift operations.*

got

Garrett Oil Tools, Inc.

P. O. BOX 8115 HOUSTON 8, TEXAS

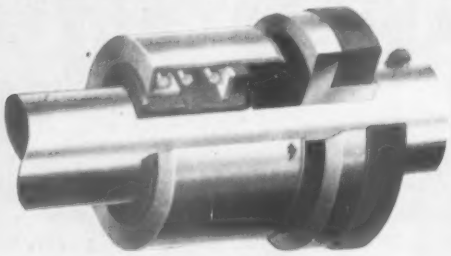
Manufacturers and distributors of the world's most complete line of gas lift valves

★ If your original gas lift valves are GOT Type "O" Valves, they can be converted to Type "O-CF" Valves at very low cost, simply by exchanging head pieces. Only GOT gas lift valves have this money-saving feature of interchangeability.

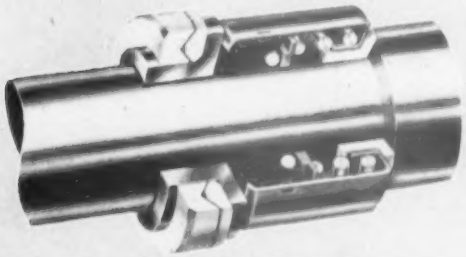
ARE YOU PUMPING WHEN YOU COULD BE GAS LIFTING?

Garlock "Package" Seals
FOR ROTATING PUMP SHAFTS

Type BB-21A—Garlock Package Seal of standard construction with brass shell, brass washer, and Buna-N bellows.



	TYPE BB-21A	TYPE AA-21A
Liquids	For water, oils, alcohol, solvents (except aromatic, chlorinated and ketone types) and other liquids (except strong acids).	For very strong acids, oils, solvents (including aromatic, chlorinated and ketone types) and all other liquids.
Equipment	Rotating shafts of centrifugal pumps, process pumps, chemical pumps, agitators and similar applications.	
Sizes	For shafts from ⅜" to 3" diameters.	
Temperatures	With Buna-N bellows up to 212°; with silicone bellows up to 450° F.	Up to 450° F.
Pressures	Up to 150 p.s.i.	Up to 150 p.s.i.



Type AA-21A—Garlock Package Seal with hat-shaped "Teflon" drive ring, brass or 316 stainless steel shell and washer, "Teflon" 'O' ring, and "Teflon" two-piece vibration ring.

✓ CHECK THESE IMPORTANT FEATURES

- ☐ Occupy very small space
- ☐ Completely assembled—ready to install
- ☐ Proven performance at low cost
- ☐ Both types are dimensionally interchangeable

In both of these Package Seals, a leakless seal is provided by a positive contact between carefully lapped metal-to-carbon mating surfaces. All metal parts in both types are available in plated-brass, Ni-Resist, stainless steel with malcomized face, Garlock "B" iron, and others.

For complete details, ask your Garlock representative or write us about your sealing problems.

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GARLOCK

PACKINGS, GASKETS, OIL SEALS,
MECHANICAL SEALS,
RUBBER EXPANSION JOINTS

derground reserves. However, here is a case where private companies can go only so far and then they must depend on the authority of the state to bring about enforcement of all the principles of conservation."

T. S. Petersen, president, Standard Oil Co. of California, in an address to the Fresno (Calif.) Rotary Club.

CALENDAR OF EVENTS

NOVEMBER

19-20 National Association of Corrosion Engineers, western region, fall conference, Biltmore Hotel, Los Angeles.
19-20 Annual Instrument Short Course, Los Angeles Harbor Junior College, applied technology division, Wilmington, Calif.
20 Natural Gasoline Association of America, regional meeting, Herring Hotel, Amarillo, Tex.
Nov. 29-Dec. 2 American Society of Mechanical Engineers, Statler Hotel, New York City.

DECEMBER

1-4 Corrosion conference, University of Oklahoma, Norman.
5 Twenty-fourth Exposition of Chemical Industries, Commercial Museum and Convention Hall, Philadelphia.
10-12 American Chemical Society, regional meeting, southeast and southwest sections, Jung Hotel, New Orleans.
13-16 American Institute of Chemical Engineers, annual meeting, Hotel Jefferson, St. Louis.

JANUARY

11-15 Society of Automotive Engineers, annual meeting and engineering display, Sheraton-Cadillac and Statler Hotels.
12-14 National Constructors Association, annual meeting, Hotel Commodore, New York City.
27-29 Ninth annual symposium, "Instrumentation for the Process Industries," Texas A. & M. College, College Station, Tex.

FEBRUARY

26 Natural Gasoline Association of America, Permian Basin regional meeting, Lincoln Hotel, Odessa, Tex.

MARCH

1- 5 American Society for Testing Materials, spring meeting, Shoreham Hotel, Washington, D. C.
3- 5 American Petroleum Institute, Division of Production, Southwestern district, Rice Hotel, Houston.
4- 5 American Gas Association, transmission and storage conference, Jung Hotel, New Orleans.
8-10 American Institute of Chemical Engineers, Statler Hotel, Washington.
15-19 National Association of Corrosion Engineers, annual meeting, Municipal Auditorium, Kansas City, Mo.
17-19 American Petroleum Institute, Division of Production, Mid-Continent district, Skirvin Hotel, Oklahoma City.

REED twin blast ROCK BITS

Slush from the nozzles of **REED** Twin-Blast Rock Bits blasts against the bottom of the hole and sweeps across at high velocity — carrying cuttings up into the return mud stream immediately so cutter teeth can work on new formation.

The result of this efficient bottom hole cleaning action is faster drilling, more hole per bit, fewer round trips and lower drilling costs.

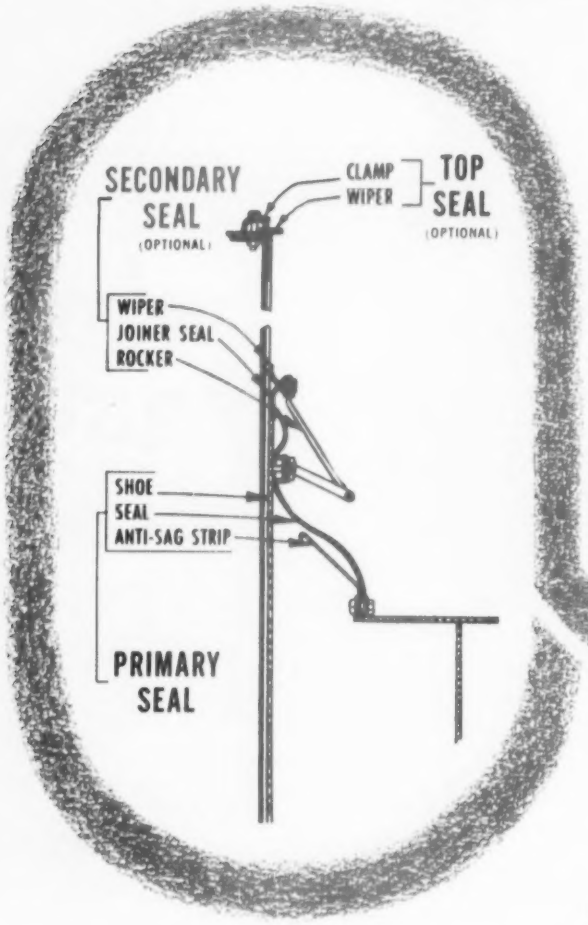
4194

REED ROLLER BIT COMPANY

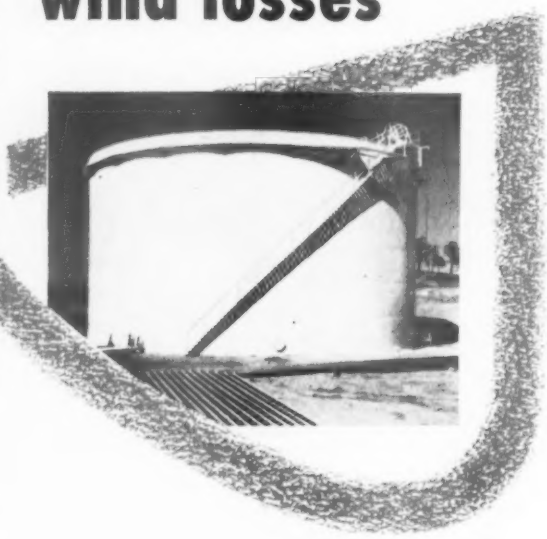
HOUSTON 1, TEXAS

the important factors in **floating roof design**

number 4 of a series



secondary seal to cut wind losses



Air currents cause a pulsating action above the primary seal which can draw vapor out of the area where the seal shoe contacts the shell.

Wiggins Floating Roofs have a Secondary Seal, a synthetic rubber coated fabric sealing ring riding against the tank shell above the primary seal. This patented Wiggins feature reduces wind action so effectively that it has been known to eliminate 50% of the evaporation losses suffered by tanks having only a single seal.

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- Special Wiggins design gives optimum strength with economical use of steel—better than normal safety factor.

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- Complete, clean drainage assures protection against peeling of paint, rusting and dangerous accumulation of water.

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- You get top-to-bottom use of tank capacity.

Pontoons
- Divided into *gas-tight* compartments for safety.
- Deep and roomy, uncluttered with framework—for easy inspection, maintenance and repair.

Only Wiggins floating roofs meet every important design specification

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GENERAL AMERICAN TRANSPORTATION CORPORATION

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THE OIL AND GAS
JOURNAL
TULSA, OKLAHOMA

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JOURNALLY Speaking

Moving Peril

DO you ever move your office or your residence? If you're like most oil men you're apt to move rather frequently—and perhaps suddenly.

Then you are concerned with the latest ruling of the Post Office Department regarding delivery of magazines to people who change addresses. It's labeled an economy step, and if it results in balancing the federal budget perhaps we shouldn't complain, but it works a hardship on magazine publishers and magazine readers. It applies to all magazines, of course, but our chief interest—and we trust yours, too—is in seeing that you never miss a copy of the Big Yellow Book.

Under the new rules, the Post Office will forward a magazine for only 12 weeks. It will do this free if the new address is in the same city. If the subscriber moves to another city and leaves a forwarding address, the Post Office will forward the magazine only if the subscriber agrees to pay postage. And postage now is charged at fourth-class zone rates instead of second-class. This means that an average-sized issue of the Journal would require forwarding postage of around 25 cents to travel about 800 miles. For a fat issue, or for a longer trip, it might cost as much as 50 cents a copy.

If the subscriber doesn't send the postage, and in any event after 12 weeks, the Post Office will destroy the magazines and just send the wrappers back to the publisher (unless we want to pay the new high return rates, which we don't). Under the old system undeliverable magazines were returned to the publisher at nominal cost, so we would trace down the subscriber's new address and send him his back copies. Now we won't have any back copies to send, so if you miss some issues as a result of your move you don't have much chance of getting a complete file.

All of this means that it is now imperative that you notify us of a change of address in advance of your move. Under the old system we could guarantee 10-day service on change of address. Now you had better give us 30 days' notice if you want to be sure not to miss a copy.

(Secretaries please note: If the men in your office are like most men they probably will forget such details in the rush of moving. So why don't you undertake to perform this change-of-address chore for them?)

Mail Education

SPEAKING of mail and magazines, we're going to get real sore at the Post Office Department if it persists in trying to wipe out its deficit by raising our postage bill. It claims it's losing $240,000,000 a year handling second-class mail — magazines and newspapers.

We (along with other publishers) claim that the department's accounting method is all wet. We say the postal system is set up primarily to give fast service to first-class mail (letters), that it wouldn't need nearly so elaborate a setup to handle magazines, and that magazine rates ought not to subsidize other services.

For example, our favorite oil publication brings a lot of revenue to the Tulsa Post Office, yet it never physically enters the building. Right in our own basement we tie the addressed copies into bundles for each city and delivery zone, weigh them, put them in sacks, and haul them to the railway mail cars. Most other publishers do the same. So the Post Office where a magazine is "entered" as second-class doesn't have to do a lick of work except check the weight and collect the postage.

Many years ago Congress established a special second-class postage rate for magazines and newspapers on the ground that they are educational and disseminate valuable information. We trust you agree that this description fits the Journal (no comments about this page, please) and that such essential publications shouldn't be blamed for the postal deficit.

—*Henry D. Ralph.*

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offers 3 ranges of

Hinge-Lok Casing Centralizers

...to provide ample all-around cementing space for all casing programs, regardless of varying hole sizes or conditions.

"REACH" (Bowed Height) IS THE VITAL FACTOR All Baker HINGE-LOK Casing Centralizers have greater reach (or bowed height) of springs in corresponding ranges than any other casing centralizers on the market. Increased reach means adequate, all-around cementing space, even though the hole size may vary considerably from the drill bit size.

WHY REACH IS NEEDED In oversize sections of open hole, centralizers with insufficient reach frequently fail to contact the wall of the hole and thus perform no work. As a result, adjacent centralizers above and below can be so overburdened that casing-to-wall contact is apt to occur. The end result is likely to be a poor cement job at any such point of contact.

The increased *reach* of Baker HINGE-LOK Casing Centralizers ensures that each centralizer will contact the wall of the hole within its range and will contribute its share toward an effective centering job.

MAXIMUM STRENGTH The engineered bow shape of the centralizer springs provides *greater landed centering force* than can be obtained from any other available hinge-type centralizer covering the same range of open hole sizes.

YOUR CHOICE OF THREE RANGES Choose the bowed height of spring best suited to meet the centering problem of your specific program. (See description of ranges, below.)

EXTRA FEATURES

- *HINGED FOR EASY MOUNTING*
- *ALL SPRINGS WORK TOGETHER*
- *UNLIMITED ROTATION OF CASING*
- *EASY STARTING WITHOUT SNUBBING*
- *ALWAYS PULLED—NEVER PUSHED*

BAKER MODEL "H" Hinge-Lok Casing Centralizers

20-RANGE
Product No. 9112
For LESS-THAN-NORMAL CLEARANCE where no problem of over-size or irregular hole is anticipated.

25-RANGE
Product No. 9113
For NORMAL CLEARANCE, where no serious problem of over-size or irregular hole is anticipated.

SUPER-RANGE
Product No. 9114
For GREATER-THAN-NORMAL CLEARANCE or where extensive hole irregularities are anticipated in otherwise normal clearance.

Call Baker for Centralizer Service

BAKER OIL TOOLS, INC. HOUSTON • LOS ANGELES • NEW YORK

The A.P.I. reflects oil's changing concepts

FOR the past several years it has been remarked that the annual meetings of the American Petroleum Institute have been putting less emphasis on the technical problems of the oil industry and devoting more attention to matters of management and public policy.

This year the trend was continued. Featured speakers discussed international relations, public relations, government policy, finance, management methods, and similar matters far removed from the scientific and mechanical matters of finding, producing, and refining petroleum.

This is both a logical and a desirable development, for two reasons:

In the first place, when the A.P.I. was formed the industry was in its early stages of the application of science, and research and standardization were prime problems demanding industry-wide cooperation and knowledge. Now individual companies and specialized societies and associations are carrying on the bulk of this work and its details are no longer of interest to all branches of the industry.

In the second place, this shows that the oil industry has become mature and realizes that it is not just a business but one of the most powerful factors in the world's economy. As such it is important that not only its present leaders but the oncoming generation of junior executives keep abreast of their responsibilities and opportunities.

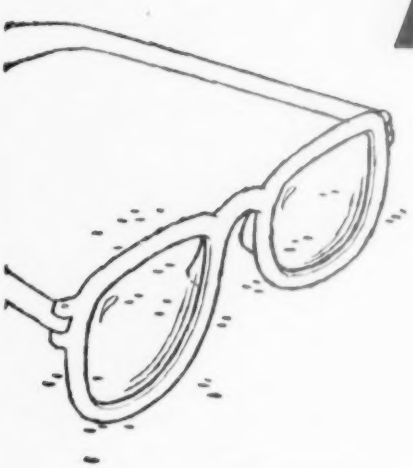
The Institute's public-relations program, for the past several years very properly a major topic of discussion at the big meeting, has now become so accepted that it, too, occupied a much lesser portion of this year's program. In its place, there was more emphasis on such management problems as methods of conveying company policy down through the ranks, and developing efficiency and cooperation among junior executives, superintendents, and foremen.

THIS year it was notable how much attention the A.P.I. gave to government policies, particularly in the international sphere. Imports of oil are currently a pressing problem and perhaps they always will be considering the amount of oil's capital and technology invested abroad. And since international oil is such a pervading factor in international peace and war it is essential that the entire industry understand the implications of this.

The industry is now realizing that its responsibilities go beyond production, conservation, and supply, beyond being a good neighbor with the public. It is now a partner with the Government in many ways and it also is a laboratory for development of the nation's leaders. The A.P.I. meeting is the proper forum for discussion of such things.

GRAVER CONSTRUCTION SERVICE LOOKS

beyond the "specs"



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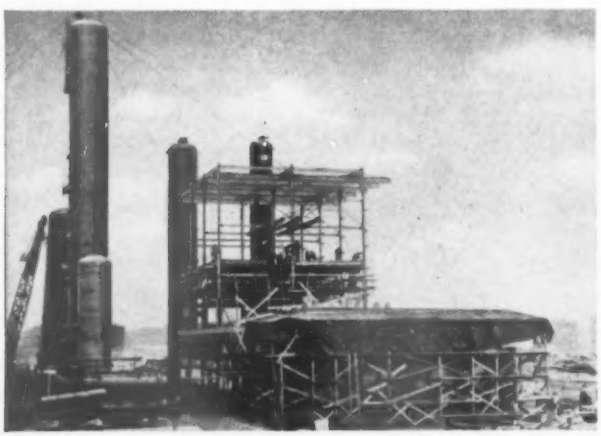

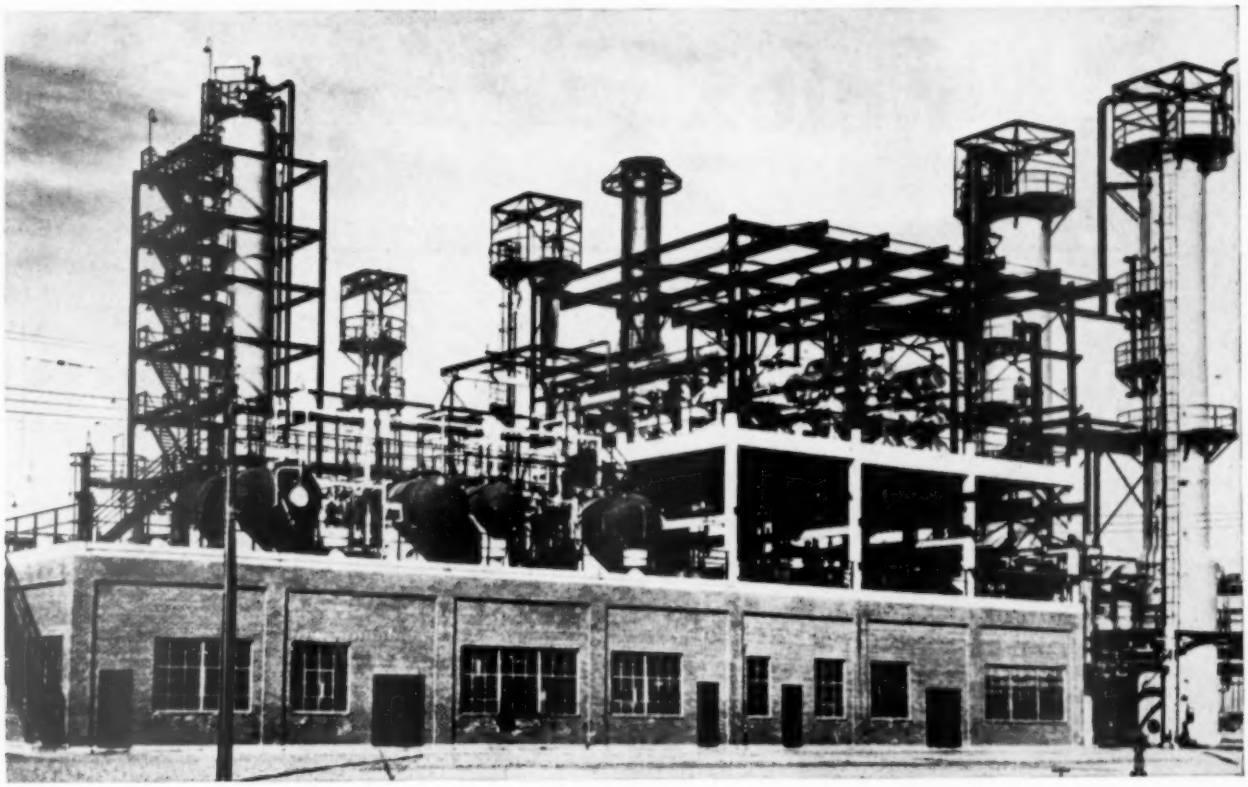

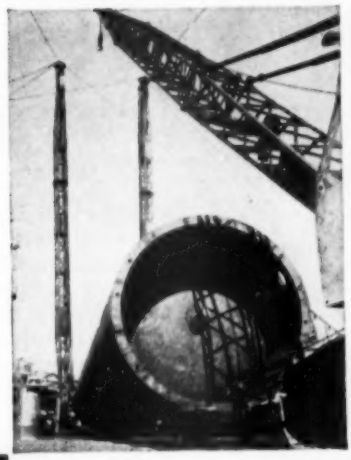

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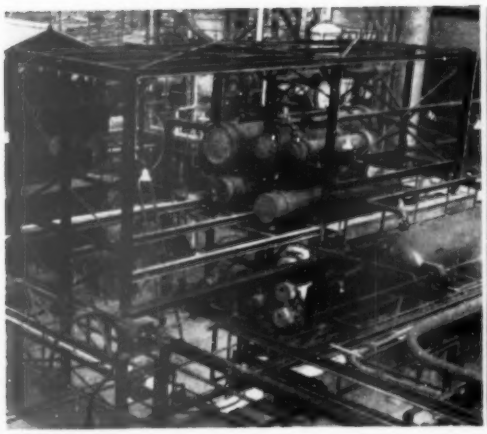
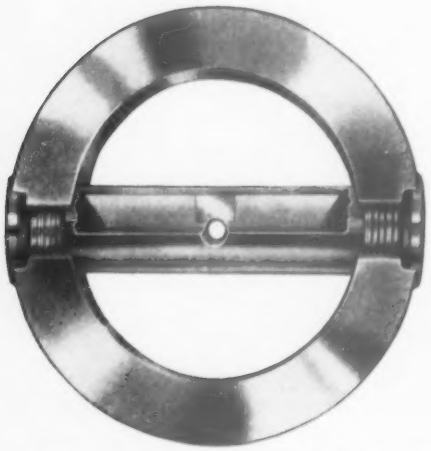


Welex

TWIN-JET



Cross section through the Twin-Jet gun with one of the Jet charges in place. The jets perforate through metallic port plugs, leaving virtually no debris in the well, because the port plugs and debris are retained in the gun.

Visual inspection of the gun on coming out of the well reveals holes in the port plugs confirming clean perforations through the casing.

ASK YOUR WELEX SERVICE ENGINEER

The Welex technical staff is ready to help you with any well completion or servicing problem. Welex offers you experienced field crews, trained and supervised by the men who originated the Jet process.

the LOW COST perforating service that gives deep, positive penetration with larger diameter entrance holes . . .

1. Twin-Jet gives you POSITIVE PENETRATION of casing, cement, and formation. There are no "duds." Holes in the port plug confirm perforation of the casing.
2. Average DEPTH of penetration is greater than with projectiles.
3. Entrance hole diameter is equivalent to projectiles.
4. There is virtually no burr left on the inside of the casing.
5. No casing damage . . . no shattering of the cement sheath.
6. Virtually no debris left in the well. Port plugs are retained in the gun.
7. Twin-Jet Guns are made in 4" and 5" O.D., giving a hole density of 4, 6, or 8 per foot from either size gun.

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THIS WEEK... ...IN THE NEWS

GRAND-BALLROOM SHOT during the thirty-third annual A.P.I. meeting shows the standing-room-only crowd which turned out to hear the public-relations session address of H. S. M. Burns, president of Shell Oil Co. Official registration at the meeting in Chicago was 6,348, down 45 from last year's 6,393. Site of the 1956 meeting again will be Chicago it was announced at the meeting. It previously had been announced that the 1954 meeting would be held in Chicago, with the 1955 meeting scheduled for San Francisco.

A.P.I.—The problem of oversupply and just how much of that condition is attributable to imports occupies much of the discussion at the A.P.I. meeting. . . . ¶John Suman, Jersey Standard vice president, contends imports are not solely to blame, that a future rise in demand will wipe out the present surplus and create the need for additional oil volume. . . . ¶The whole affair is an industry problem and not one for Government says Secretary of the Interior McKay, and his view gets the wholehearted endorsement of P. C. Spencer, Sinclair president and new A.P.I. board chairman. . . . ¶Spencer urges the industry to solve the problem without any government intervention, while urging "restatement" of antitrust law to permit industry cooperation to provide the excess capacity needed for war without undermining oil's price structure. . . .

REFINING—Standard of Indiana unveils its new catalytic reforming process, "ultraforming" which employs a reserve reactor which successively replaces each of the other cases in series during catalyst regeneration. . . . Fluor Corp. gets contract for first fluid coker at Carter's Billings refinery.

PIPE LINES—Lakehead Pipe Line finishes construction, begins testing 645-mile, 30-in. crude line from Superior, Wis., to Sarnia, Ont. . . . Completion of this project makes the combined Interprovincial-Lakehead system the longest continuous crude-oil main line in the world at 1,765 miles. . . . ¶Tennessee Gas announces $45,000,000 expansion program to boost capacity of its system 130,100,000 cu. ft. to a new total of 2.1 billion cubic feet. . . .

DRILLING—Shell's 1 State A wildcat in Harding County indicates in tests it may be South Dakota's first discovery well. . . . ¶For the first time in more than 20 years, North Dakota may have a commercial gas well. . . . An extremely shallow wildcat, 1 Brudvik, in Renville County, tests apparent commercial gas at 303 ft. . . .

ACTIVITY—Production of crude and lease condensate averaged 6,208,525 bbl. daily for week ended November 7, up 22,225 bbl. daily. . . . ¶Total well completions for the week decreased 24 wells to 1,051. . . . ¶Wildcat completions increased 16 wells to 233. . . . ¶Rotary rigs operating in the United States increased 53 rigs during week ended November 9 to 2,774, highest since December. . . .

TRENDS—Total well completions for the 5-week period ended November 7 averaged 1,055 wells per week compared with an average of 877 for same weeks last year. . . . ¶Wildcat completions averaged only 224 wells per week for the past 5 weeks compared with 223 for the same period last year. . . .

INTEREST IN PUBLIC RELATIONS was demonstrated by this standing-room-only crowd in the Grand Ballroom of the Conrad Hilton Hotel which heard the address of H. S. M. Burns, president of Shell Oil Co.

ANXIOUS MOMENTS preceded the talk. Burns' train from New York was derailed and he arrived just in time for the session.

Oversupply Chief A.P.I. Topic

General feeling at thirty-third annual meeting is that industry's problems are short-term, can be worked out

CHICAGO. — Imports and surplus supplies of oil were not on the program of the American Petroleum Institute's thirty-third annual meeting here November 9-12, but they were the chief topic of discussion nonetheless.

So far as the subject got into major speeches in the formal sessions there was general agreement that the oversupply is serious but probably of short range, and that the industry can work out a solution without government intervention.

Capsuled comments included:

. . . Secretary of the Interior Douglas McKay—Imports and foreign trade are necessary and the Government has created a commission to make a study of our foreign economic policy, but it is not the job of the federal Government to tell the industry how to operate or to do anything at all about temporary dislocations of the market.

. . . John Suman, vice president of Standard Oil Co. (N. J.)—The domestic oil industry is operating at new high levels for the year. The current curtailment of crude production is not due entirely to imports, and the outlook for further expansion in demand for oil promises a bright future for a healthy and growing domestic oil industry.

. . . Frank M. Porter, A.P.I. president—The present oversupply could impair the industry's ability to prepare for future expansion but this need not be alarming if the problem is recognized and if all elements involved will do their fair share toward correcting conditions.

. . . P. C. Spencer, newly elected chairman of the board of the A.P.I.—Solving the problem of oversupply will not be simple and will require the best brains of the industry. But it can be solved without government intervention, though industry action would be much easier if the Government would clarify its foreign oil policy and restate the antitrust laws to permit companies to discuss common problems in the national interest.

These views occupied but a minor portion of the 4 days of busy sessions devoted primarily to discussion of technical and managerial problems, but among the more than 6,000 oil men present those interested in the industry's economic position were cheered that the seriousness of the surplus problem was publicly recognized by men of such prominence.

The two A.P.I. officials further amplified their views at press conferences held during the course of the meeting.

Spencer, himself head of a company with foreign interests, freely admitted that imports constitute a problem and one which will tax the ingenuity of all concerned, but he added that there never has been a time when the oil industry did not have problems and he hoped that this one, like others, would be solved without federal legislation but by self-restraint, self-control, and individual action.

Excess capacity is a threat to the stability of the market, Spencer said, and yet it is necessary to have some excess capacity as a cushion for national security. In the meantime, he said, anything that cuts down the present surplus of oil on the market will be a step toward solving the immediate problem, and there should be restraint on domestic production as well as on imports.

Referring to his formal proposal for restatement of import policy and antitrust procedure, Spencer asked:

"Why is the Government so cagey about telling us what it wants us to do and what it is going to do? The oil industry probably has the biggest obligation to national defense of any in-

"I'M NOT HAPPY but I'm not pessimistic" about the supply situation, A.P.I. President Frank Porter told the press. Peaks and valleys are routine, Porter said, and this one will work itself out, too. Beside Porter is Fred Van Covern, director of the A.P.I.'s department of statistics.

dustry, so why won't the Government give us the means to fulfill that obligation?

"We want no favors or relaxation of the antitrust laws except that when the Government asks us to cooperate in solving a problem of national policy or national interest, then we should be allowed to get together and discuss the problem without threat of antitrust prosecution for doing what we are asked to do."

Spencer added that he did not feel that the current surplus capacity in the oil industry would have much effect in curtailing capital expenditures next year. Most companies usually start planning a new year with the idea of keeping down new investments but usually end the year by spending even more, he observed, and said that he sees no reason why the oil industry will spend less for new facilities.

Some striving is apparent on the part of importers to curtail shipments in line with curtailments ordered by a number of producing states, he said, and it would seem that imports could be reduced to a reasonable balance within a decent length of time. He noted the factors making it difficult for importers to make big reductions suddenly, but said that not a great number of barrels per day is involved in the desired readjustment.

The Journal's Coverage

These first-hand reports of the thirty-third annual meeting of the American Petroleum Institute are brought to you by six members of the Journal editorial staff who attended the sessions. They are K. B. Barnes, Henry D. Ralph, Ted Armstrong, George Weber, and Paul Reed. Petroleo Interamericano, the Journal's Latin-American affiliate, was represented by Oscar B. Irizarry, editor.

New Officers Named

Sinclair president elected new chairman of the board

CHICAGO.—P. C. Spencer, president of Sinclair Oil Corp., New York, was elected chairman of the board of the American Petroleum Institute here last week to succeed L. S. Wescoat, president of Pure Oil Co., Chicago.

Frank M. Porter, president of Fain-Porter Drilling Co., Oklahoma City, was reelected president of the Institute.

Charles S. Jones, president of Richfield Oil Corp., Los Angeles, was elected vice president for the division of transportation to succeed Spencer.

Vice presidents reelected for another 1-year term include John G. Pew, vice president of Sun Oil Co., Philadelphia, production division; John W. Newton, vice president of Magnolia Petroleum Co., Beaumont, Tex., refining division; and Robert M. Bartlett, vice president of Gulf Oil Corp., Pittsburgh, marketing division.

B. Brewster Jennings, president of Socony-Vacuum Oil Co., Inc., New York, was reelected treasurer, and Lacey Walker, A.P.I., New York, was reelected secretary and assistant treasurer.

Thirteen new directors were elected to fill vacancies and expiring terms and eight members-at-large were reelected by the board. The new directors include D. T. Staples, Tide Water Associated Oil Co., San Francisco; C. E. Spahr, Standard Oil Co. (Ohio), Cleveland; Rodney S. Durkee, Lane-Wells Co., Los Angeles; M. E. Montrose, Hughes Tool Co., Houston; A. S. Knowles, Parkersburg Rig & Reel Co., Parkersburg, W. Va.

T. M. Martin, Lion Oil Co., El Dorado, Ark.; Stanton K. Smith, Smith Oil & Refining Co., Rockford, Ill.; Harry W. Bass, H. W. Bass & Sons, Dallas; Robert G. Dunlop, Sun Oil Co., Philadelphia; Charles Z. Hardwick, Ohio Oil Co., Findlay, Ohio; J. Ed Warren, Midland, Tex.; Dwight T. Colley, Atlantic Refining Co., Philadelphia; and Lloyd F. Bayer, Tide Water Associated Oil Co., San Francisco.

The board declined to accept the resignation of B. I. Graves incident to his retirement from Tide Water Associated Oil Co., and he will continue as a director in his personal capacity.

Surplus a Problem

Defense slowup requiring adjustment, Porter warns

CHICAGO.—The most pressing problem facing the American petroleum industry is achieving a balanced level of defense effort consistent with maintaining a stable and lasting economy, Frank M. Porter, president of the A.P.I., declared in opening the general sessions.

Now, when we have a leveling off of defense expansion, we must make special efforts to maintain our economy, and we must avoid temporary palliatives in doing so, he said.

Porter mentioned specifically the current problem of oversupply, saying:

"Today we have a situation of excess petroleum supply that is more than equal to meet the short-term, peacetime demand of the immediate future. This burden, however, of the current surplus, in itself, can reduce the industry's ability to meet the long-term demand for future supplies that are the results of the efforts that are being made today.

"In making this statement I do not intend to be an alarmist for I have the utmost confidence in the industry's ability to meet and resolve the prob-

NEW CHAIRMAN of the Oil Industry Information Committee is G. Stewart Brown, director of public relations for Standard Oil Co. of California, here listening intently to a group-session address at the A.P.I. meeting. Brown succeeds Stanton K. Smith, of Smith Oil & Refining Co., Rockford, Ill.

No Help Wanted

Industry's problems are tough ones, Spencer tells A.P.I., but Government shouldn't be called in to find solutions

CHICAGO.—Current problems of the oil industry—specifically imports and excessive producing and refining capacity—should be solved by the industry itself without any government intervention or regulation, the A.P.I. was told by P. C. Spencer, president of Sinclair Oil Corp. and newly elected chairman of the board of A.P.I.

Admitting that he had no ready solution, Spencer said the problems require the best thinking of the industry, and reminded his listeners that oil men pride themselves on having achieved their present position through free enterprise and without government controls.

He did offer two proposals, which, he stressed were his individual views and not necessarily those of the A.P.I. or his company.

. . . **Antitrust law** revisions geared to modern-day realities so that oil companies can engage in a reasonable amount of cooperation with each other and with government agencies in solving common and national problems.

. . . **National foreign policy** revision with respect to the oil activities of United States nationals in foreign lands, such as formal governmental approval of the policy statement of the National Petroleum Council.

To remain vigorous, he said, the industry must be strong in the conviction that it can continue to supply an abundance of oil and dynamic enough to attract the huge amount of new capital required for expansion.

It is the critical importance of petroleum to national security that has brought us some of the most perplexing problems with which we must grapple over the near future, Spencer said, mentioning specifically the surplus producing capacity of 1,000,000 bbl. per day together with surplus capacity of refineries and other facilities built up at the request of the government.

"No practical member of the oil industry was surprised at the consequences," Spencer said. "Increased available oil insists on a market. Surplus refining capacity cries out for use. There is not enough storage capacity to stockpile the potential extra supply.

"I know of no simple or easy solution to the industry's tasks of today and tomorrow. There is no easy solution, but of this I am certain—each of us must be prepared to sacrifice a little of his own interests for the sake of the national welfare. Each of us must bear his share and carry his part of the common burden."

lems with which it is currently faced.

"Many in the industry are disturbed over the surplus and there is cause for alarm but only to the extent that we critically analyze and recognize the conditions which are responsible for the present situation."

Imports . . . Porter described the governmental and industry conditions which led up to the present supply situation, and said that the nation should recognize that excess capacity was built up at government request but at industry expense, and that the industry should not be expected to price its products below its costs. Turning to the import situation, he said:

"By and large there is general recognition that the volume of imports necessary to supplement domestic production is desirable and important, and there is full agreement that imports in volumes that will impair the vigor and health of the domestic industry are undesirable.

"There is, however, a wide difference of opinion as to the level of imports which would satisfy this complicated equation. The problem should be properly rationalized and an era of understanding achieved consistent with the many factors involved."

Porter praised the action of state regulatory bodies in curtailing production under their conservation laws as a major contribution to balancing supply with demand, but he also called on all elements and individuals of the industry to carry their share of the effort to maintain a stable economy.

Import Lid Vetoed

McKay sees no need for Government intervention

CHICAGO.—The administration will take no steps to place a limitation on oil imports at this time, the A.P.I. was told by Secretary of the Interior Douglas McKay.

He admitted that the industry has a current problem of oversupply and that imports are a factor in this, but said "This is a time of readjustment, it is not a time of calamity."

"Nor am I saying that I think there should never be a point to which imports might be reduced in order to prevent serious danger to the domestic industry. What I am saying is that I see no need, no excuse, for any Government dictation to the industry on this pressing problem — or on any other."

The basic principles on which the administration has been operating in this field, McKay said, are these:

1. Our ultimate and last-ditch strength must lie in domestic resources.

2. We must not permit ourselves to be forced to a last-ditch stand, so the frontiers of our defense lie well beyond our natural borders. We cannot base our policies on counsels of despair or on the assumption of an island America.

Security consideration . . . To strengthen the Free World we have had to encourage development of petroleum resources throughout the Free World, and to abandon this policy now would defeat our objectives for lasting security, McKay said.

The importation of foreign oil permits other countries to purchase large volumes of American products.

The secretary told the oil men that the administration wants to do everything possible to insure a strong, dynamic, expansive domestic industry, but at the same time it must protect the economies of other nations of the Free World.

IMPORTANCE OF FUNDAMENTAL RESEARCH was stressed in a morning-long session, the first group meeting of the annual A.P.I. program. At the microphone is T. W. Nelson, Socony-Vacuum Oil Co., Inc., chairman of the Advisory Committee on Fundamental Research on Occurrence and Recovery of Petroleum. At left is Robert E. Wilson, Standard Oil Co. (Ind.), chairman of the research committee of the A.P.I. board of directors.

Basic-Research Report

Industry's work continually shedding new light on basic aspects of technology, fundamental-research group told

CHICAGO.—There is no reason to fear that the oil industry is running low on its fund of basic scientific information.

While the vast technical advances of recent years have made it draw heavily on a long-accumulated fund of basic technical information, the high withdrawal rate has been offset by a replenishment program sponsored on behalf of the industry by the A.P.I.

The current status of that program—now 26 years old—was laid before the industry here last week. The reports indicated one thing: The industry's fund of facts is solvent.

This program on fundamental research concerns many phases of study of the origin, composition, occurrence, recovery, and phase behavior of petroleum and natural gas.

This year's meeting was sponsored by the Committee on Fundamental Research on Occurrence and Recovery of Petroleum (ACFRORP). The session was convened by Robert E. Wilson, chairman of the research committee of the A.P.I. board of directors and chairman of the board of Standard Oil Co. (Ind.). Briefly reviewing the entire research program, he restated the board's support of annual sessions to present the research story to the industry.

The program's history was reviewed and its administration outlined by T. W. Nelson, Socony-Vacuum Oil Co., chairman of the A.P.I. advisory committee on Fundamental Research on Occurrence and Recovery of Petroleum.

"The A.P.I. research program has grown steadily, until it consists of nine projects—at an annual expenditure of $663,000," he reported. About 40 per cent of this budget goes into the occurrence and recovery phase of study.

Hydrocarbon behavior . . . A major project in the over-all program is the 26-year-old project on the fundamentals of hydrocarbon behavior. This work has produced much significant information on the reservoir behavior of hydrocarbons which has had a marked effect on the technology of petroleum production. A new phase of the study is now under way, said J. E. Sherborne, of Union Oil Co. of California, who is chairman of the research project advisory committee.

The project is presently concerned primarily with a non-equilibrium behavior. This is believed to be as important as the long-standing equilibrium studies, in its contribution to production technology.

Studies of gas and liquid diffusion under a wide range of pressure and temperature conditions and with supersaturation under similar conditions are under way. This work will initially be restricted to simple mixtures of hydrocarbons.

The project also includes preparation of a monograph on thermodynamic properties of hydrocarbon and related mixtures, as well as developments of techniques for increasing the range of applicability of "equations of state" for the prediction of hydrocarbon behavior.

New work on displacement . . . A second phase is well under way in the over-all A.P.I. Project 47 on the mechanism of the displacement of oil from porous materials.

Reporting progress on this new work was Morris Muskat, of Gulf Oil Corp., chairman of the research project advisory committee. Completed and terminated over a year ago, was Project 47a, which resulted in the perfection of techniques to measure relative permeability. This phase also demonstrated that, at least for the porous materials studied, the relative permeability to oil, in the presence of immobile interstitial water, is independent of the pressure gradient.

Now well under way is Project 47b, which was begun in 1949 at the University of Oklahoma. This phase is directed to the study of the microscopic flow and displacement processes in porous beds by direct visual microscope observations.

The progress report revealed that this project has established that, when oil and water flow simultaneously in the synthetic granular media used in the investigation, these phases occupy and flow through independent channels and do not share and crowd through the same pore passageways, except possibly at the channel interfaces.

Also revealed: differences in the manner in which displacing fluids progress through porous matrices, depending on their wettability for the solid surface, and their relative viscosities.

Just commencing at University of Texas is Project 47d. This will explore fluid-solid interactions as they bear on wettability phenomena involved in the initial distribution of reservoir fluids in porous rocks and in their displacement from such rocks. Quantitative measures will be determined for the interactions involved in adsorption processes, heat changes and free energy and entropy changes. This information

is expected to shed important new light on outstanding problems of oil-recovery processes.

Sediment studies . . . New help in finding ancient shore lines is resulting from 2 years of study on Project 51, on near-shore recent sediments and their environments in the northern Gulf of Mexico. Progress in this phase was reported by C. L. Moody, of Ohio Oil Co., advisory committee chairman for the project.

New techniques make it possible to distinguish among Texas coast samples at least 14 environments in the embayments, on the barrier islands and on the open Continental Shelf. This work has indicated the importance of the barrier sand islands as potential stratigraphic sand traps.

Grants in aid . . . An effective means of encouraging research important to the industry is the grant-in-aid program sponsored by the ACFRORP. This helping hand for university research was discussed by L. Laskaris, of Atlantic Refining Co.

Currently, three research workers, each studying some phase of the occurrence and recovery of petroleum, are receiving financial grants from the A.P.I. They are located at Pennsylvania State College, the University of Tulsa and Iowa State College. Characterized by a freedom from red tape and guided by Institute liaison members, these grants supplement the main research efforts through which the A.P.I. is steadily augmenting the vital non-competitive study of the nature of petroleum.

Imports Not to Blame

Suman tells production division future rise in demand will erase "temporary" surplus, require more oil volume

CHICAGO. — The current "temporary" oversupply of crude cannot be blamed entirely on imports, but even if it could, an expanding demand will wipe out present surpluses and require still larger volumes of oil, John R. Suman, vice president of Standard Oil Co. (N. J.), told the A.P.I. production division.

The spokesman for one of the largest importing companies, addressing an audience composed chiefly of domestic producers, said the anticipated increase in consumption of petroleum products makes the prospects bright for continued growth of the domestic producing industry.

He urged his listeners to be bullish on the domestic industry and to avoid talking themselves into a decline in activity, saying "if we persist in gloomy forebodings, if we keep proclaiming publicly that we are weakening, we may really get weak."

Suman readily admitted that capacity to produce crude oil today is greater than current producing rates, but he recalled that this has been the case frequently in the past and insisted that the condition would be corrected by rising demand within a relatively short period.

Reviewing the conditions which caused rapid expansion of producing capacity both here and abroad during the past 2 or 3 years, and considering the time lag in bringing new oil reserves into position to produce, Suman said it is surprising that the industry's momentum did not carry it even farther ahead of demand temporarily.

Domestic factors . . . Blaming the present oversupply on imports is an oversimplification, Suman insisted, as it ignores many domestic factors. In spite of that, he said, domestic crude production in 1953 will set a new record and be some 4 per cent higher than last year, and the drilling rate and proven reserves also are at new highs.

Next year, he said, the forecasts indicate an increase in demand of 3.6 to 5 per cent, with continuing big increases in consumption over the next 20 years—all indicating that the domestic producers will have a ready market for all they can produce except during short-term periods of adjustment of temporarily excess capacity.

Imports . . . Turning to imports, Suman decried the talk of "floods" and "torrents" of foreign oil, saying that imports of crude, not considering the Pacific Coast region, have remained about 10 per cent of domestic production, have fluctuated only 1½ percentage points, and are lower in percentage in 1953 than in 1950.

The Jersey company, Suman said, has cut its crude imports from 103,000 bbl. per day a year ago to 83,000 bbl. per day at present, a drop of 19 per cent, and the company's ratio of crude imports to refinery runs is lower than it has been in any of the postwar years.

"As I am sure you know," he said, "we in Jersey believe that imports play an important supplemental role to domestic production. On many occasions over the past years, Jersey spokesmen have stated the view that such supplementation is consistent not only with the long-range preservation of national security, interests of the American consumer, and the sound growth of international trade but also with the welfare of the domestic industry.

"We still hold to those beliefs we have expressed many times before—that imports are valuable and should be flexible, that a strong domestic industry is essential, and that the domestic industry is strong.

"That imports are playing a supplementary role is evidenced, we feel, by the fact that the domestic industry set an all-time record for production in 1951, topped it in 1952, set a new record in 1953, and will probably hit still another in 1954."

Internships Urged

Engineers lack training for management positions

CHICAGO.—Now that industries are tending more and more to draw technically trained men into management they should give more consideration to the type of training engineers need for such positions, the Division of Production was told by Dr. W. V. Houston, president of Rice Institute, Houston.

The solution, he said, lies in having colleges give a general education and scientific background and then developing a sort of engineering internship within industry where engineer graduates would learn the particular problems of the company.

Dr. Houston criticized the tendency for engineering schools to teach craftsmanship and impart experience, such as the details of how to drill an oil well, which can better be learned after leaving school. Instead, he said, engineering schools should teach science and theory plus enough general university education to permit a graduate rise to a managerial position.

"The only function in which a university can be really effective," he said, is to provide the general education and the scientific background against which an engineer can place his experience.

"It seems probable that there must eventually develop for engineers, as there is now for medical doctors, some scheme of engineering internship by which an engineer, after he has received his degree and completed his university work, spends one or more years in engineering employment which is specifically organized to give him practical experience. Many large industries provide something of this kind in their training courses, and it could be that further development along these lines can be expected."

Unit Accords Urged

Cooperation called answer to public domain problems

CHICAGO.—Many of the problems of oil operations on the public domain in Rocky Mountain states could be solved by a more cooperative attitude toward formation of unit agreements, it was declared in a paper presented to the Division of Production by Lon J. Putnam of Gulf Oil Corp., Denver.

Explaining that the best way to surmount the acreage limitation on federal leases is to form a unit agreement approved by the Department of the Interior, Putnam said that many operators feel that the department's regulations reserve to it too much authority to dictate operating and management policies.

However, his own view is that while the delegation of powers is broad, experience shows that government officials seldom interfere with actual operations and are concerned chiefly as umpires to assure fair treatment of all parties and to assure greatest recovery of oil and gas.

Putnam said that the chief difficulty lies in the habit of operators in delaying and bickering while drawing up unit agreements. He cited two main causes:

. . . **Failure of the operators** to delegate to the negotiators the authority to make decisions.

. . . **The large number** of lawyers who argue over details of phrasing.

"Why should we competitively drill many costly wells in a pool when one-half the number will actually produce more oil?" he asked.

"Why create duplicate investment costs when they can be avoided by unitization? Why let our natural energy be dissipated by selfish competitive methods when we have a device by which it can be avoided?

HEART OF THE A.P.I. MEETING is committee sessions such as this one, a joint meeting of the planning committee of the Central Committee on Accident Prevention and of the planning committee of the Central Committee on Fire Protection. Members are shown listening to a report by Harry Markee, lower right, of Phillips Petroleum Co., Bartlesville, Okla., and chairman of the committee on awards of the accident-prevention body.

Offshore Problems

Rules for Shelf may curb all tidelands production

CHICAGO.—Offshore oil is not a bonanza and the amount of oil recovered from the Continental Shelf will depend in large part on the type of regulations imposed by the federal Government, the Production Division was told by Clayton L. Orn of Ohio Oil Co., Houston.

The two "tidelands" laws enacted by Congress this year reopen for development a potential petroleum domain one-tenth the size of the land mass of the United States, but Congress retained for federal administration an area 10 times as large as that returned to state jurisdiction, he pointed out.

Offshore oil may cost three or four times as much as onshore oil with which it must compete, and the cost may be raised even higher by the nature of federal regulations still to be promulgated, Orn said.

Another factor which may increase the cost is the various workmen's compensation and navigation laws which Congress made applicable to the Continental Shelf, he said, as well as the special restrictions imposed on construction of pipe lines to the shore.

Conservation is another problem yet to be solved, according to Orn, for Congress refused to apply the conservation rules of the adjacent states and as yet the federal Government has no machinery for this purpose.

Finally, he warned, if considerable production is developed in the federal portion of the Continental Shelf there will be the problem of applying market-demand proration, since this oil will compete with that from regulated states.

Drilling Test Tool Described

CHICAGO.—Marked success is being made in the development of equipment for percussion drilling by hydraulic power through the use of a new measuring instrument called the drop tester, it was reported to the Division of Production by John V. Pennington of Drilling Research, Inc., Houston.

So far, however, the studies are still of a laboratory nature and have been confined to the fundamental principles of rock fracturing, and the equipment is not yet ready for field tests, he reported. The speaker gave no promises of early application of the percussion method to actual oil-well drilling, but said that the research has resulted in means for measuring the effectiveness of various types of bits and blows, and of comparing percussion with conventional bits.

The studies described by Pennington include such aspects as the speed and force of the blows, distance between chips, angle of chisel points, and similar variable factors.

His chief conclusion was that the best drilling is obtained with a frequency of 200 to 300 blows per second rather than at very high frequencies. He added, however, that experiments with electrical instead of hydraulic percussion might show that good results could be obtained with cycles of 60 or 120 blows per second.

MARKETING EXPERTS who addressed a group session of that division included, left to right, Dr. Charles Allen Thomas, president of Monsanto Chemical Co., St. Louis; A. W. Peake, president of Standard Oil Co. (Ind.), Chicago; H. A. Inness Brown, publisher of the Gasoline Retailer, New York; and R. M. Bartlett, vice president of Gulf Oil Corp., Pittsburgh, and A.P.I. vice president for marketing.

Competition Ahead

Surplus producing and refining facilities will create era of "survival of fittest," marketing division told

CHICAGO. — Surplus facilities mean strong competition ahead, A. W. Peake, president of Standard Oil Co. (Ind.), told the A.P.I.'s Division of Marketing here last week.

These facilities, an excess producing and refining capacity of 1,000,000 bbl. a day, will be maintained "as long as our national interests require," Peake said, although they create a problem which is "one of the major tasks we face in the industry."

Besides this surplus capacity, there are two other factors which will tend to sharpen competition to a point of "survival of the fittest," Peak said. They are:

. . . **The flattening-out** of the demand curve for petroleum products as the industry approaches a demand "plateau."

. . . **Encroachment of foreign oil** in the domestic market, with imported crude and products pressing for an "ever-increasing proportion."

The extra producing and refining facilities were built after the Korean war started as a matter of military preparedness, and construction will continue in order to maintain a 1,000,000-bbl. surplus, Peake said.

What to do . . . Peake outlined a six-point program to meet the stiff competition ahead and which he urged companies to adopt.

. . . **Keep an eye on costs.** In a case of "survival of the fittest," the fittest "are those of us with the lowest costs."

OPENING THE FIRST SESSION of the Division of Marketing is R. M. Bartlett, vice president of Gulf Oil Corp., Pittsburgh, and A.P.I. vice president for marketing.

. . . **Appraise sales personnel** for loyalty, initiative, profit-mindedness, ability to meet new demands on them, and idea productivity.

. . . **Train personnel,** developing their potential talents.

. . . **Apply scientific** approach to marketing, using research to determine customer desires, location of sales outlets, and effectiveness of advertising.

. . . **Streamline administration,** keeping decision-making power close to activities.

. . . **Keep posted** on economic trends, remembering that forecasts are on a national average and do not necessarily reflect demand in a particular area.

"The courage to call for an adequate price which permits a fair profit is a part of sound selling," Peake said. "People talk about pricing themselves out of the market on the high side; they can also price themselves out on the low side—in fact, they can price themselves out of business."

Atoms in industry? . . . In another paper presented before the Division of Marketing, Dr. Charles A. Thomas, president of Monsanto Chemical Co., urged the petroleum industry to direct the attention of its scientists to the possibilities of atomic energy in oil.

Declaring that atomic energy is a field for private initiative rather than government monopoly, Thomas suggested several studies as a practical field of research for the petroleum industry. They include:

. . . **Exposure of polyethylene** to electron beams to enable it to withstand steam sterilization. Several polymers show improved characteristics after exposure to radiation.

. . . **Use of radiation** within automobile cylinders, since there is a possibility it would improve the efficiency of burning. It could result in a reduction of weight of a diesel engine, if radiation should lower surge pressure at the instant of ignition.

. . . **Use of ionizing** radiation at the proper temperatures and pressures to manufacture gasoline from natural gas.

Sales Policy Hit

Dyer slaps at "give away" selling of industrial oils

CHICAGO.—The oil industry's traditional practice of selling industrial oils at prices frequently below actual production cost was criticized roundly here last week.

Speaking before a lubrication session of the Division of Marketing at the annual A.P.I. meeting, J. E. Dyer, vice president of marketing of Sinclair Refining Co., New York, said "There was never any real justification for this very unsound 'loss leader' type of selling, but I don't think I am wrong in saying that the practice persists even today."

"There is something wrong basically

in the marketing policies of a selling organization which 'gives away' one product in the fallacious assumption that it will bring the sale of other products, on which a relatively high profit will enable it to equalize and sweeten up his sales realization."

What is needed in the industrial-oils division of lube-oil marketing, Dyer said, is "better marketing management, sounder sales policies, and a stiffening of the backbones of some of our lubricating-oil sales people."

"As marketers, I think we should firmly resolve to address ourselves resolutely to the idea of brand-name merchandising of industrial oils at prices which will return a fair and reasonable profit after giving effect to such pertinent elements of cost as advertising, technical services, engineering surveys, periodic inspections, etc."

A.P.I.—FINANCIAL

Balance Praised

Financial, accounting men called impartial umpires

CHICAGO.—Finance and accounting officers of business firms have come a long way since the day of the bookkeeper, his high stool and goose quill, but they still have a long way to go.

That implied challenge was tossed to those who attended the A.P.I. Financial and Accounting session here last week by Reese H. Taylor, president of Union Oil Co.

Taylor commented on the growing importance of accounting personnel to industry and outlined several unsolved problems which he said he would like to see his listeners tackle.

"Because they can produce, analyze and interpret factual information from within and without a company, financial and accounting officers have increasingly assumed the function of impartial umpire," Taylor commented. He said that while different departments within a company compete for individual projects, the full acceptance of a single department's aim might not be good for the business as a whole.

"You now help top management develop programs which are balanced fairly and objectively for the best interests of the company as a whole," he told his listeners.

Taylor told the group that research "in your realms of knowledge" may help in smoothing out future economic cycles. He said he would like for the accounting and financial officers to undertake the following:

. . . **Capital investment research** to determine the impact of capital expenditures on business cycles and to determine if they can be timed to better advantage.

. . . **Application of mathematical** techniques to daily operating problems to make for more efficient production and scheduling with less clerical exertion.

. . . **Objective evaluation** of new investment propositions to give management an idea of what a given proposition could be expected to return under certain assumed conditions.

Keys to Success

Personnel and organization are essentials of business

CHICAGO.—If men in the financial and accounting fields are to discharge fully their key responsibility to modern business management, they must maintain sound organizations manned with "growing" people who are prepared to meet challenges.

That, in essence, was the theme of "The Twin Keys to Successful Management" presented at a financial and accounting session of the A.P.I. last week by Donald P. Jones, Sun Oil Co. comptroller.

"Our responsibility goes far beyond record keeping," Jones declared. "We must be at the right hand of operating management every step of the way, keeping them currently informed on how each phase of their operation is doing, showing them where to look for trouble spots, and advising them on the proper mix of activities so that the best results may be achieved."

In order to fulfill that role for management, Jones advocated:

. . . **Wise distribution** of responsibility within an organization as a major factor in efficiency.

. . . **Recruiting personnel** for future managerial positions.

. . . **Training programs** to better fit personnel for moving up in a more successful organization.

Organization . . . Organization is the keystone upon which the skillful direction of any activity depends, Jones declared, adding that "too much stress cannot be laid on the caliber of men selected as subexecutives."

Once those subexecutives are chosen, Jones declared, they then must be delegated authority that will enable them to enter into the spirit of their assignments with enthusiasm and initiative. Then, in order to make certain the delegation is of a useful nature to management, there must be some means to allow the top executive to check and determine if the responsibilities are carried out.

Personnel . . . Once the most promising men have been selected for possible continuing use to management, they must be trained, Jones declared. He warned that often training programs are costly and create unproductive time for the trainee while they are in progress. However, Jones declared, the most important single phase of executive responsibility involves the "acquisition, training, and development of competent personnel to assure an never-ending stream of young executives who are growing through the organization into positions of prime responsibility."

STATISTICAL ADVISORY COMMITTEE of the A.P.I., which met in an all-day session typical of many of the A.P.I. committees which conduct their work before and during the annual A.P.I. meeting.

HEAD TABLE at a group session of the Division of Refining. Demonstrating a point on fluid coking is A. Voorhies, Jr., Esso Standard Oil Co., Baton Rouge, La. Others from the left are L. C. Burroughs, Shell Oil Co., New York; T. T. Whipple, Lummus Co., New York; and J. W. Newton, Magnolia Petroleum Co., Beaumont, Tex., who presided.

Contact Coking Analyzed

Lummus engineers say first commercial test shows process more flexible, economic than conventional delayed coking

CHICAGO.—Analysis of 8 months' operation of the first commercial continuous contact coking unit shows that the process has greater flexibility, better operational characteristics, and more favorable over-all economics than conventional delayed coking, the Division of Refining was told last week in a paper authored by Valentine Mekler, A. Schutte, and T. T. Whipple, all of Lummus Co.

The first commercial unit was erected in the McKee refinery of Shamrock Oil & Gas Corp., Sunray, Tex. It was designed to process vacuum-distillation residue from Panhandle crude oil—at a nominal charge rate of 1,000 bbl. per day—for the production of gas, gasoline, gas oil for catalytic cracking feed, and coke.

The unit has been in operation for the past 8 months, and yields over a wide range of operating conditions have been obtained. Advantages of the contact process, as proved in this operation, were outlined by the authors as follows:

... **Heavier residues** can be handled than with the conventional delayed-coking process.

... **Flexibility** of the process permits processing stocks of widely different characteristics to obtain wider ranges of yields and product specifications.

... **Need for intermittent cleaning** of coke drums is eliminated.

... **Product coke** is clean, hard, uniform in size, and easily handled and marketed.

... **Capital investment** and operating labor are less than delayed coking.

Process economics . . . Based on the experience with the 1,000-bbl. per day unit, there is under design a 2,500-bbl. per day unit, which incorporates the modified mechanical features.

An economic comparison of a 2,500-bbl. per day continuous contact coking unit vs. a delayed unit has been prepared on the basis of charging Panhandle vacuum bottoms. The comparison indicates that, at this capacity, over-all economics favor the contact coking process, they said.

When credit is allowed for the potential recovery of olefins in product gas at a value of 3 cents per pound, the total differential profit is $2,171,280 per year. The corresponding figure for a delayed coking unit is $1,656,480 per year. The difference favors the contact coker by $514,000 per year, the authors said.

Process steps . . . The unit, the authors said, consists essentially of: (1) a reactor in which the oil-wet coke particles or "seed" coke flow downward as a dense bed with sufficient time provided in the reactor for the cracking, coking, and drying reactions; (2) a reheater in which the circulating coke is raised in temperature to supply the heat of reaction and some sensible heat to the feed, and to make up radiation losses; (3) a coke-circulating system which uses the "mass-flow" principle to elevate the coke as a dense unagitated column; and (4) a fractionation system to separate products.

The vacuum-residue feed is introduced into the bottom of the fractionator, where it is mixed with recycle stock and further preheated in a tubular heater to approximately 700° F. This feed is mixed thoroughly with the hot circulating coke stream.

The lighter portions of the feed are vaporized, and the heavier constituents are retained on the coke particles as a liquid film. As the coking reaction proceeds, the film is converted into gas, hydrocarbon vapors, and residual coke, and the latter is retained on the seed particle.

Continuous drawoff . . . As successive increments of coke are deposited, a gradual increase in coke-particle size occurs, the authors pointed out. The larger particles, which have a diameter of approximately ½ in. or more, are drawn off continuously as product coke to maintain a nearly constant coke inventory in the system.

The vapors from the reactor, at a temperature of 900° F. to 1,000° F., are quenched and released to the fractionator. From the bottom of the reactor the dried coke is elevated to the disengager by a low-pressure mass lift which is "powered" by the reactor pressure of 35 psig.

The coke from the disengager flows by gravity to the reheater, where it is heated to between 1,000° F. and 1,100° F. by gas firing or by burning a portion of the coke. The reheated coke is discharged intermittently by gravity into the lock tank, from which it flows into the lift tank to start another cycle of the coke circuit.

The energy for circulating the coke is supplied by 150-psig. steam at the lift tank. The sequence of coke flow from the reheater and lock tank is controlled automatically by a cycletimer.

This is the first commercial installation of the "mass-flow lift" developed by Union Oil Co. of California, they said. The coke circulation is continuous and smooth. The rate of flow is controlled by a rotary star valve above the reheater. Only one coke level must be controlled—that of the reheater. The coke-circulation rate may be increased or decreased by varying the speed of the rotary star valve.

The ratio of oil to coke for normal operation is 10 bbl. of oil per day per ton of coke circulation per hour, i. e., 1 lb. of oil per 14 lb. of coke circulated.

Fluid Coking Proved

New S.O.D. process said to require substantially less outlay for investment and operation than older methods

CHICAGO.—Successful operation of a 100-bbl. per day continuous fluid coking unit for more than a year shows that this process can be adapted to commercial operation without undue difficulty, refiners were told here last week.

In a paper presented at an A.P.I. Division of Refining session, A. Voorhies, Jr., and H. Z. Martin, Standard Oil Development Co., said the process is truly continuous in that no periodic shutdowns for removal of coke are required, and the reactor can be maintained continuously at the desired operating conditions.

The single reaction vessel required is considerably smaller than for delayed coking. Estimates indicate that the process will be lower in investment and operating costs than are the older coking methods, they said.

Commercial applications . . . Standard Oil Development Co. is making the process available to the industry under license at reasonable royalty rates. Affiliates of Standard Oil Co. (N. J.) have plans for building three fluid cokers in the United States.

The first commercial unit, already in the design stage, will be installed at the Billings, Mont., refinery of Carter Oil Co. This 3,800-bbl. per day unit is scheduled for initial operation in late 1954, the authors said.

Esso Standard Oil Co. plans to follow about a year later with a 10,000-bbl. fluid coker at Baltimore and a 21,000-bbl. unit at Baton Rouge, they said.

Other advantages . . . Aside from the continuous nature of fluid coking, the process possesses some other advantages over conventional delayed coking, the authors said, in that:

. . . No preheat furnace is required. Residuum is normally available at 500° F. to 700° F., and this temperature is adequate for good feed dispersion.

. . . There appears to be no feed limitation if the stock can be handled in pumps and pipes. Fluid-coking pilot plants have been operated on feeds which vary in boiling range from whole crude to residuum having close to a 1,200° F. initial boiling point.

. . . The circulating coke system operates exceedingly well.

. . . No coke is formed in overhead equipment. A recent run on the 100-bbl. per day unit was terminated voluntarily after more than 500 hours at the design conditions without any pressure drop in the overhead lines up to the point where quench oil is normally introduced in commercial equipment.

PRESIDING OFFICER at the Division of Refining group sessions was John W. Newton, vice president of Magnolia Petroleum Co., Beaumont, Tex., and A.P.I. vice president for refining.

. . . Coke yields are close to the Conradson carbon of the original feed. In the delayed coking process, coke yields are closer to twice the feed Conradson carbon.

Properties of fluid coke . . . The coke produced in fluid coking has some interesting and unique properties, the authors said. Its fine, but uniform, particle size makes it as easy to handle as a fluid, but, nevertheless, it is a clean, dustless solid.

The roundness of the particles is a property which may make possible some unusual applications. The low content of hydrogen and of volatile matter in the coke are an indication of the calculation which takes place in the burner vessel.

The coke is expected to find its way into the already established markets for petroleum coke; e. g., as fuel and for electrodes, they said.

Process features . . . The unit consists basically of a reaction vessel and a burner vessel, the authors said. Operating pressures are substantially atmospheric but may be higher if desired. The residuum feed is preheated and then is injected into a bed of hot fluidized coke particles which are formed in the process.

These spheroidal coke particles are small, although generally somewhat coarser than fluid cracking catalyst, and thus provide a large amount of surface per cubic foot of fluidized material.

This large surface serves the multiple functions of: (1) Retaining the pitch during conversion, (2) aiding in the evaporation of products, and (3) providing an area for coke deposition.

The basic function of the fluid coke is that of a heat carrier, they pointed out. Rapid heat transfer is obtained by virtue of the fine particle size of the fluid coke. As the feed is injected into the reactor, it is, therefore, heated up very quickly.

At reactor temperatures the viscosity of the residuum is low so that its distribution over the surface of the fluidized solids is rapid and uniform. In the reaction zone the heavier fractions of the feed stock are only partly vaporized, most of the cracking reaction being effected in the liquid phase.

However, the more volatile products are rapidly evaporated from the surface of the coke so that the products consist of a dry overhead vapor and dry coke. Excellent mixing takes place in the fluid bed, and this gives virtually isothermal conditions in the reactor, just as is the case in fluid catalytic cracking.

The vapor products from the fluid bed are taken overhead through a cyclone separator located in the upper end of the reaction vessel, the authors said. Most of the entrained solids are separated at this point and returned to the fluid bed. The overhead products, with a small amount of coke dust, is then passed to fairly conventional refining equipment.

Some recycle bottoms are returned to the reactor in order to carry back the small amount of coke which has escaped through the cyclone and to permit recracking of the bottoms into the gas-oil boiling range.

The heat for carrying out the coking process is generated in the burner vessel. The fluidized coke from the reactor, which has been steam-stripped in the bottom of the reactor, is transferred to the burner by a standpipe riser system.

Air is supplied at the bottom of the burner, and only enough coke is burned to maintain the system in heat balance. For example, the temperature in the fluid-bed burner may be maintained in

the range of 1,100° F. to 1,200° F. In a typical installation the amount of coke burned is equivalent to 4 to 5 per cent by weight on feed.

If desired, extraneous fuels may be substituted for the coke burned. The heat from the burner vessel is transferred to the reactor by the maintenance of a flow of solids between the two vessels.

Particles growth . . . Because only a part of the coke deposited is burned to supply heat, the coke particles grow in size during the process, they said. In order to counteract the growth process and to maintain a constant particle-size coke inventory, fine coke must be added continuously to serve as growth "seeds."

The seeds required can be supplied either by grinding withdrawn coke in external equipment or by devices in the unit itself. However, because the seek coke is much smaller in diameter than the average of the withdrawn coke, the weight of seed required is only a small percentage of the weight of coke withdrawn.

The process is flexible in the range of permissible operating conditions. Higher or lower temperatures may be employed. Also, there is considerable flexibility in the choice of particle size of the circulating fluid coke. However, this circulating coke generally is somewhat coarser than the normal fluid cracking catalyst, which is largely material through 100-mesh, they said.

A.P.I.—TRANSPORTATION

1953 OFFICERS of the Division of Transportation, caught together during the thirty-third annual A.P.I. meeting. Left to right are R. G. Dunlop, Sun Oil Co., vice chairman of the general committee; L. S. Wescoat, Pure Oil Co., retiring A.P.I. board chairman; P. C. Spencer, Sinclair Oil Corp., retiring A.P.I. vice president for transportation and new board chairman; and George H. Hill, Jr., Cities Service Co., secretary of the general committee.

How to Pipe Propane

First attempt at regular long-distance shipment through major products carrier described by Phillips engineers

CHICAGO.—Growing production of L.P.G. and sharply increasing consumption of these products, usually at locations remote from the production source, are creating a strong need for efficient pipe-line transportation of propane.

Wholesale participation of the products pipe-line industry in carrying propane is not foreseen, J. W. Boyd, J. O. Richardson, and D. A. Roach, all of Phillips Pipe Line Co., Bartlesville, Okla., told the A.P.I. Division of Transportation pipe-line symposium. Some systems, however, are geographically located to connect large sources of L.P.G. with concentrated markets, and these probably will be called upon to transport propane and other L.P.G. regularly.

Transportation of propane poses two major problems, the authors said. These are:

. . . **The high cost** to the shipper of conventional storage.

. . . **The difficulty** of economically maintaining the critical specifications during pipe-line transportation.

Phillips Pipe Line Co., one of the first large pipe-line systems to begin major deliveries of propane regularly, is almost ideally set up for this activity, the authors said.

Individual tenders of propane on the company's 950-mile products line from Borger, Tex., to East Chicago, Ind., run from 25,000 to 55,000 bbl. at 10-day intervals.

The propane is received into the system at Borger at a rate of 60,000 bbl. per day. Butane is used as a buffering material on each tender. Phillips' needs for butane for sale to L.P.G. customers and for blending in motor fuel are such that each propane tender is usually preceded by about 10,000 to 15,000 bbl. of butane and followed with about 5,000 bbl. of butane.

Specifications . . . Critical specifications of propane which must be maintained during pipe-line shipment involve dryness and residue. The dryness specification, determined with the cobalt bromide test which permits maximum water content of 20 parts per million, is not considered a problem on the Phillips system since all products are dehydrated before entering the pipe line.

The propane in order to be salable, however, must pass a combined residue and oil-stain test which Phillips believes is the most critical part of the entire operation.

To perform this test, a 1,000-cc. sample is allowed to evaporate or "weather" at a final temperature of 100° F. Only ½ cc. of nonevaporative residue can remain, representing a maximum contamination of 1 part in 2,000. This residue must pass a test for oiliness in which the residue is poured through a filter paper. If the product passes the test it will not leave an oil stain on the filter paper.

All pumps handling propane are multistage, centrifugal units. Use of mechanical seals with the pumps has proved highly satisfactory, the authors said.

One pumping problem has been the necessity for maintaining sufficient pressure at the intake of each station and at high points along the system to keep the propane in a liquid state.

To prevent such an occurrence, charts were prepared for each section advising the station as to the correct back pressure to maintain based on the expected arrival time of the propane at

the station. The necessity for carrying high back pressures and the lower head developed by centrifugal pumps on propane results in a slight reduction in pipe-line capacity, but this is partially offset by the product's favorable friction characteristic.

Storage . . . In addition to the 64,000 bbl. of propane tankage at Borger, Phillips has 36,000 bbl. of pipe storage at Paola, Kans., 12,500 bbl. of aboveground storage at East St. Louis, Ill., and 282,000 bbl. of miscellaneous storage at Kankakee, Ill.

Heart cuts of propane are taken both at Paola and at East St. Louis, and the propane arrives at both these points completely on specification. After take-offs at East St. Louis, the remaining propane, together with the butane-propane mixture in the buffers, is carried on to Kankakee, Ill., where the pipe-line stream empties into a 285,000-bbl. cavern mined from a shale formation at 215 ft. The pure butane portion of the buffer is taken on to East Chicago. The remainder is fractionated at Kankakee to provide specification propane, which is then stored in aboveground tanks and pipe storage totaling 6,800 and 31,000 bbl., respectively.

No Terrain Too Tough

Scores of improvements in equipment and techniques have made it possible to lay pipe lines practically anywhere

CHICAGO.—Relatively recent innovations in pipe-line construction equipment have made it possible to lay a pipe line almost anywhere.

Speaking before a pipe-line symposium sponsored by the A.P.I. Division of Transportation, C. C. Bledsoe, Midwestern Constructors, Inc., Tulsa, said two examples of tremendous obstacles which can now be overcome were the crossings of this year of the 20,000-ft.-wide, 240-ft.-deep straits of Mackinac by Lakehead Pipe Line Co. and of the Canadian Rockies by Trans Mountain Oil Pipe Line Co.

Today, Bledsoe said, angle dozers and bulldozers up to 140 draw-bar horsepower have replaced smaller dozers for right-of-way work. These giants, together with gasoline-powered chain saws, have enabled the clearing of right-of-way over almost any type of terrain.

Major advances have been made in equipment to take rock out of the ditch, Bledsoe said. Rippers have become common, and, in some part of the country, have increased the production of backhoes and ditching machines 100 per cent. One of the latest pieces of equipment to facilitate removal of rock by blasting is the quadruplicate rock drill supported by a sideboom tractor. The tractor pulls the necessary air compressors. Another such improvement is the hydraulically controlled rock drill mounted on a movable framework attached to the side of a crawler tractor. The air compressor, on the back of the tractor, is connected to the power take-off. This machine permits rock drilling from a horizontal to a vertical position.

Ditching and bending . . . Ditching machines now are being manufactured which can dig a trench 54 in. wide and 10 ft. deep. These are supplemented in rough country by specially designed backhoes. The recent trend has been to use tractor-type tracks on backhoes and clams.

Almost all bends, he said, now are made cold—either by using a bending machine or a shoe mounted on a sideboom tractor. Experience has shown that it is wise to use an engineer with the bending crew to calculate the exact curvature of the ditch.

Welding . . . Probably the most significant change, Bledsoe said, has been in the operation of the welding gang. The method now most widely accepted combines the old stove-piping and firing-line methods. It involves placing one joint at a time in a continuous line, but not finishing the weld. Welding is completed by a crew known as the firing line.

Practically all modern lines are electric-welded. Welding machines are mounted on a four-wheel rubber-tired wagon and pulled into position by a tow-cat or farm tractor. Gasoline or diesel-driven generators supply the necessary current.

Another recent change in welding procedure is the use of hot-pass welders immediately behind the stringer-bead welders. This was necessary to keep from cracking the stringer-bead welds in high-tensile pipe and from preheating the pipe. To keep production rates high it has become common practice to use three or four stringer-bead welders.

Many small tools have been devised to speed up welding. Among these are the internal lineup clamp, which eliminates the need for tack-welding the pipe, and the buffing machine, which cleans the welds between passes.

Protection . . . Protection of pipe from corrosion — by coating or cathodic means, or both—has become practically universal. To clean and apply primer to the pipe, a traveling-type cleaning machine with a primer-applying attachment is run. A sideboom tractor cradles the pipe in front of the cleaning ma-

THERE'S NOTHING FUNNY ABOUT CORROSION, but that was the subject as this head-table shot was snapped during a meeting of the Committee on Pipe-Line Technology. Speaker is R. A. Brannon, Humble Pipe Line Co., Houston, chairman of the subcommittee on internal corrosion in crude-oil pipe lines and tanks. At left is J. C. Stirling, Service Pipe Line Co., Tulsa, chairman of the subcommittee on pipe-line construction practices. Center is H. H. Anderson, Trans Mountain Oil Pipe Line Co., Vancouver, chairman of the committee.

PIPE LINERS AT THEIR ANNUAL BANQUET. This group at the head table includes, from the left, Oliver C. Clinger, president of Oildom Publishing Co. and club secretary; Loren Kable, Standard Oil Co. (N. J.); Burt E. Hull, chairman of the board of West Coast Pipe Line Co.; O. F. Moore, Ohio Oil Co., retiring president of the Pipe Liners Club; J. L. Latimer, Magnolia Petroleum Co., new club president; Fayette B. Dow, National Petroleum Association; and R. B. McLaughlin, Texas Pipe Line Co.

chine. A recent development here has been to run the exhaust from the engine through the tank to heat the primer, thus achieving a more-uniform primer thickness.

In the coating process a sideboom tractor cradles the pipe ahead of the coating machine, and one or two sideboom tractors equipped with belt slings are used behind it. The modern machine is capable of coating pipe and applying two different wrapping materials to the pipe at the same time. Technical advances in equipment in this field include: (1) Propeller and sweep agitators, (2) Rubber crawlers on the traveling machines to keep them from gouging the pipe, and (3) Holiday detectors to detect thin spots in the coating.

Lowering-in and tying-in, except where a large number of tie-ins are required, have been combined into one operation. Equipment usually consists of three sideboom tractors and one or two clams for digging out plugs which might be left in the ditch.

Backfill and cleanup require the same basic equipment with the addition of a farm tractor and disk to return the land as nearly as possible to its original condition.

Line testing has become more exacting, Bledsoe said. Currently, a scraper is pushed through the line under air pressure and the line air tested. Hydrostatic testing is common in some parts of the country.

U. S. Getting Out

Private firms to regain transport responsibility

CHICAGO. — The federal Government is getting out of the transportation business, Robert B. Murray, Jr., Under Secretary of Commerce for Transportation, Washington, told a Division of Transportation session at the A.P.I. meeting here.

The only exceptions, Murray said, are in those activities required by national-security needs and those promotional and regulatory processes which can be clearly justified as responsibilities of the Government.

Budget cut . . . The entire budget of the Commerce Department of which about 95 per cent is for transportation, has been cut from $1,127,000,000 to $846,000,000. At the same time, Murray said, department operations have been tightened and improved.

After many years of much talk and little action, the Government this year sold the Federal Barge Lines for $9,000,000, an amount close to the accumulative losses sustained by the system during Government ownership from 1939 to 1952. The sale of the lines to private owners will yield annual revenue to the Government and has removed the Government from one area of competition with private enterprise, he said.

The administration also has proposed to Congress that the Government, through the department's Maritime Administration, offer a trade-in-and-build program to tanker operators whereby existing active tankers over certain age limits would be purchased for placement in a readily available lay-up status in the National Defense reserve fleet. In exchange for this, new tankers would be built by the operators. This proposal, Murray said, is intended to correct a situation which finds the United States with insufficient new high-speed tankers in the active fleet and no usable tankers in the reserve fleet to meet the sudden impact of a national emergency. The proposal is that the current-age limit of 12 years for trade-in tankers be reduced to 10 years.

Other administration moves . . . Other actions in the transportation field by the current administration, Murray said, have been the:

. . . Lifting of all restrictions on construction in American yards of ships for private account.

. . . Passage of legislation liberalizing federal insurance of private loans for shipbuilding to encourage entry of private money into this phase of financing.

. . . Launching of a study of the decline of coastwide and intercoastal shipping to determine what policy actions may be desirable.

Standardization Urged

Well-planned company program cuts costs, record keeping and engineering and purchasing work, buyers' group told

CHICAGO.—A wisely conceived and applied standardization program can save an oil company a great deal of money, time, and trouble, the Oil-Company Buyers' Group was told during the A.P.I. meeting here last week.

Examination of the results of a company-wide standardization program started in the late 1940's by Stanolind Oil & Gas Co. has convinced the company that the value of such a program is well worth while, according to W. L. James of Stanolind.

Stanolind's project, James said, has enabled the company to:

. . . **Approach uniformity** in design layouts whether in northern Wyoming or southern Louisiana.

. . . **Reduce records** which must be kept.

. . . **Simplify work,** both engineering and purchasing, involved in obtaining materials.

. . . **Better disseminate** ideas and knowledge within the company.

. . . **Streamline purchasing** transactions and reduce processing time.

. . . **Achieve cooperation** between the purchasing department and other units of the company which it otherwise might not have had any contact except on a purely impersonal plane due to the large size of the company.

Intangible benefits such as these, James said, are hard to evaluate in terms of dollars. Stanolind believes the cost accounting required to make such an evaluation would be almost impossible to set up and might cost more than the knowledge is worth, but the monetary savings and the increase in efficiency and safety definitely have been substantial.

How to get started . . . Starting a standardization program isn't easy, James said. It usually is regarded suspiciously by both company personnel and sources of supply. Among the latter, a feeling of suspicion is apt to crop out that employes are to become automatons operating from a book of standards that leaves no room for self expression on their part with regard to new ideas or taking advantage of future new developments by suppliers.

The first step in setting up a standardization program, he said, is to decide on what level to standardize—whether to concentrate on just the barest essentials and the cheapest way of doing something, or to go all out and develop extremely fancy standards, or to settle on some in-between policy.

To carry out the first step, Stanolind's standardization committee, composed of representatives of the operating, engineering, accounting, safety, purchasing and material departments and of each division office, prepares a questionnaire and submits it to all divisions, districts, and field locations for information, comment, and recommendations.

The replies are analyzed and information tabulated for presentation to the committee. With this information, the committee works up a recommended standard and presents it to management.

How rigid should it be . . . To issue such a standard and subsequently leave the field wide open would defeat the program. To confine the degree of flexibility too closely would do likewise. Stanolind handled the problem in two ways. When a change in an existing standard on design or layout of facilities is desired, a letter is directed to the chairman of the study group for consideration. If the idea has merit, the change can be effected at a meeting or by petition of all concerned in the company. Equipment standards, however, are somewhat more rigid, and, in order that the company insure itself that some new product is not bypassed because of this, a procedure for testing new equipment is available as an avenue for considering such items.

The various standards are printed and submitted in bound form to all offices within the company on which they may have a bearing. The manual then becomes a workable part of the program.

A prime example of how standardization can simplify records, requisitioning, and purchasing was Stanolind's solution to its christmas-tree problem. Prior to standardizing, the company had 58 different types of christmas trees in use. Present standards, James said, call for three basic types with five variations. Other standards of the design or layout class were developed for blow-out preventer assemblies, tank batteries, fencing, pulling units, work trucks, etc.

Stanolind's other type of standard, that for actual equipment, is arrived at in about the same fashion as a design standard with the exception that policy and price consideration play a major role. An engineering analysis of existing equipment is made. As complete information as possible is collected from each manufacturer, and each item of equipment is compared to arrive at some order of preference.

Pump problem . . . James urged that a concerted effort be made by the A.P.I. manufacturers, and using companies toward simplification and standardization of bottom-hole pumps.

Though there are only five basic A.P.I. types, James said, a survey will show over 1,000 variations on the market. Results of a study by Stanolind, James said, showed that the company had 962 different pumps in use. As a result of cooperation between engineering and the field offices, that number has now been reduced to 182 different units which are now in the process of being published for use by the fields in ordering, he said.

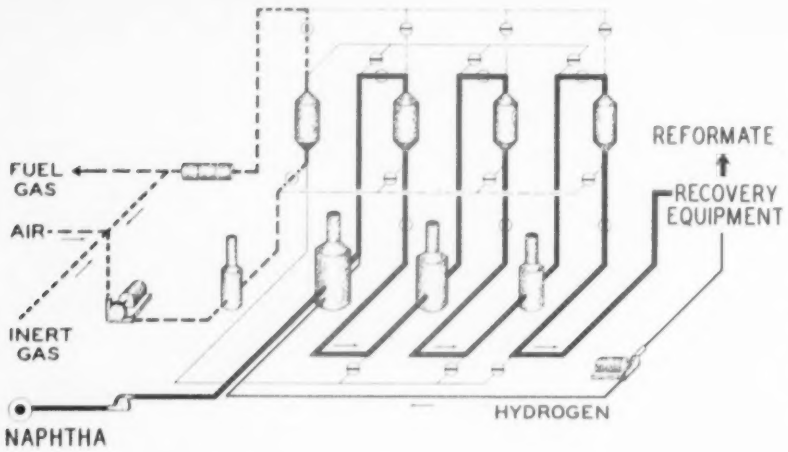
Tubular-goods availability . . . Assuming drilling operations next year will be maintained at about this year's level, the supply of oil-country tubular goods produced by domestic mills will be about in balance with requirements, Jay W. Owings, Republic Steel Corp., Cleveland, told the buyers.

By the end of the year two new seamless mills and two new electric-weld mills should be in full operation, Owings said. These should contribute roughly 600,000 tons of tubular goods annually. During the break-in period next year, however, output probably will run closer to 375,000 to 400,000 tons.

This production, he said, will just about offset the tonnage of foreign and conversion pipe used during the past few years and should ease the oil-company tubular-goods procurement problem substantially.

Drill pipe, Owings said, may be hard to find. Demand for 5½-in. casing continues to run extremely high, and this pipe will continue to be scarce. N-80 casing availability should improve. Butt-weld pipe, Owings continued, is in good supply at present, but if 1954 turns out to be a boom year for construction, supplies may tighten up.

Demand for intermediate sizes of line pipe should continue strong, while that for large-diameter line pipe should slacken due to reduction of large long-range bookings. If several big projects now under consideration become firm, however, delivery promises for large-diameter pipe could become extended overnight, Owings said.



New Reforming Process

Indiana Standard introduces Ultraforming; cyclic catalyst regeneration method said to be key to improved operation

CHICAGO. — Ultraforming, a new catalytic reforming proceess incorporating a unique method of regenerating catalyst, was made available to the industry last week by Standard Oil Co. (Ind.)

The process is the result of several years' development at Standard's Whiting, Ind., research laboratories, augmented by many years of commercial reforming experience in the company's refineries. At present, three commercial units with total capacity exceeding 36,000 bbl. per day are under construction by Standard and affiliated companies. Other units are in the design stage.

Ultraforming is a fixed-bed process employing a platinum catalyst. The unit design is conventional up to a point incorporating three or more reactors in series with facilities for interstage heating of charge stock. It differs from other platinum catalyst units in the addition of a reserve or "swing" reactor which successively takes the place of each of the other cases during catalyst regeneration.

Regeneration . . . Standard's new method of cyclic regeneration serves to maintain catalyst performance at its peak. The company considers this feature to be its principal contribution to the technique, since it affords continued operations at a high level of catalyst activity and selectivity.

Research representatives point to three major advantages deriving from cyclic catalyst regeneration at regular intervals. It permits continued operation of the process at low operating pressure contributing to higher over-all reformate yields. This feature, they state, will quickly pay for the regeneration equipment and the higher catalyst inventory required for the additional reactor.

At lower pressures the ceiling on octane is raised, since gasoline of higher octane number can be produced before the increase becomes too small to offset the loss of yield. The third advantage is said to be greater flexibility, since catalyst life is less affected by variations in feed composition or changes in operating conditions.

Results of periodic catalyst regeneration are illustrated in the chart showing Ultraforming's operating pattern for typical pilot-plant runs. In each cycle, the catalyst shows normal decline in activity, requiring an increase in reactor temperature to maintain desired product octane. A nominal decline in gasoline yield accompanies the increase in reactor temperatures.

Standard says its method of regeneration so thoroughly restores the catalyst, that the temperatures required to maintain product octane are no higher in successive cycles than they were in the first cycle. In some cases, as the chart shows, catalyst activity is actually improved after the first regeneration.

The pattern depicted in the chart was obtained from a pilot-plant run which has now reached nearly 30 bbl. of naphtha per pound of catalyst. The first three cycles represent about 3 months of actual operation.

Other accelerated pilot-plant tests have been run on a high boiling-point feed stock at low reactor pressure, in deliberate attempts to evaluate catalyst life. One such test has reached the eighteenth cycle with no harmful effect on the catalyst.

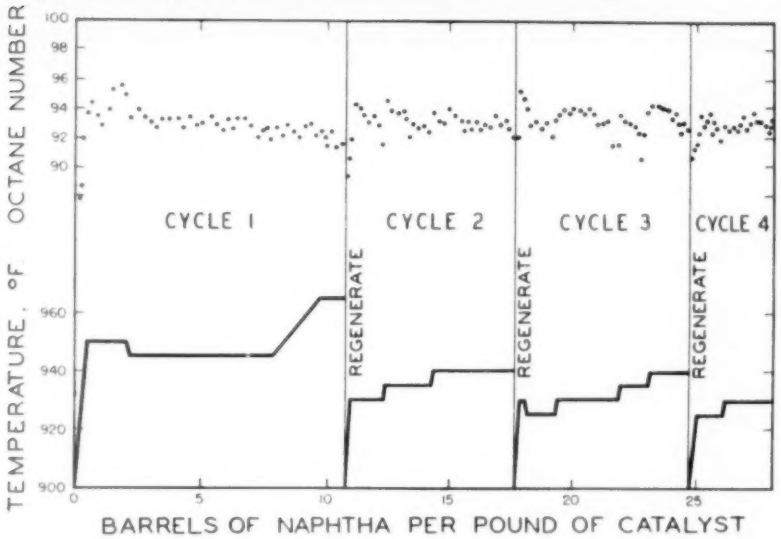
Intensive pilot-plant operations are continuing at Whiting to determine how many times the catalyst can be regenerated to a practical level of activity. This information must be determined before optimum end-point limits for various types of feed stock can be evaluated.

Results . . . Pilot-plant results charging four typical feed stocks for two octane levels each are summarized in the accompanying table. All data were ob-

Ultraforming Yields From Various Feed Stocks

FEED:	GULF COAST		—MID-CONTINENT—				ARKANSAS	
A.S.T.M. distillation, °F.:								
Initial	274		206		119		113	
10%	284		237		174		159	
50%	315		274		257		237	
90%	363		324		332		325	
End point	392		361		378		375	
Composition, vol. %:								
Paraffins	21.5		50.0		55.0		77.0	
Naphthenes	57.0		41.5		38.0		15.0	
Aromatics	21.5		8.5		7.0		8.0	
Research octane number	57.0		44.5		49.4		47.8	
OCTANE LEVEL	90	100	85	95	85	95	85	90
YIELDS:								
10-lb. gasoline, vol. %	109.3	96.2	103.0	92.0	98.5	87.5	93.0	84.7
C_{5}+, vol. %	91.0	84.0	89.9	82.8	88.7	78.3	82.8	77.5
Butanes, vol. %	3.3	6.4	3.1	5.5	4.1	8.0	8.9	11.6
Dry gas, wt. %	4.4	8.6	4.8	8.4	5.1	10.0	7.0	9.1
Hydrogen, cu. ft. per bbl.	875	1,050	970	1,150	870	1,060	530	600

Operating Pattern of Ultraforming



tained at reactor pressures of 300 psi. with required product octane governing reactor temperatures.

The effect of lower pressure on yields is illustrated by results obtained on a low-boiling Mid-Continent naphtha. At 300 psi. Ultraforming produced 2 per cent more 10-lb. R.v.p. gasoline than at 500 psi. when operating for 85 Research octane product. At the 95-octane level, the lower pressure increased yield by about 10 per cent. At 200 psi., the yield picture improves still further. Pilot-plant runs on a similar Mid-Continent feed stock at 200 psi. and 500 psi. at a 95-octane level, show a 5 per cent increase in the yield of C_5 plus product at the lower pressure.

While the economic limit of reformate octane number is dependent largely on feed stock composition, Standard reports that with several naphthas tested, a Research octane number of 100 clear is entirely feasible. The Gulf Coast naphtha shown in the table is a case in point. With Mid-Continent naphthas, they report that the octane ceiling is at least 97.

The lower pressure permitted in the Ultraforming process serves to promote dehydrogenation and aromatization while reducing hydrocracking to a minimum. This results in a high production of hydrogen, and lower yields of light hydrocarbons. In commercial operation, catalyst selectivity, may be the determining factor in deciding when to regenerate catalyst.

Design of Ultraforming units will follow the schematic flow chart. This depicts the operation during regeneration of catalyst in the swing reactor, employing a heated mixture of flue gas, air, and an inert gas.

A unique valving arrangement developed for this process simplifies the cyclic regeneration of successive cases and permits better control in substituting the extra case for each of the other cases.

Catalyst life . . . On the basis of pilot-plant tests to date, a catalyst life of 30 to 60 bbl. of reformate per pound of catalyst is certain. According to Standard, 90 bbl. or more per pound can be expected in favorable operations. Replacement cost will be about $4.00 per pound, including charges for recovering the platinum from the used catalyst. Hence, catalyst costs are estimated to range from 4 cents to 13 cents per barrel. The catalyst is to be supplied by American Cyanamid Co. which cooperated in its development.

Licensing . . . Licenses for the process, available from Standard, will give operating rights under relevant company patents including those covering future improvements. Licensees also will have access to confidential information on the process.

The first of the three Ultraforming units now building to go on stream is a 6,800-bbl. per day unit scheduled for completion next spring at the El Dorado, Ark., refinery of Pan-Am Southern Corp. A 9,000-bbl. per day unit is being added at Standard's Wood River, Ill., refinery.

The largest unit so far contracted is a 21,000-bbl. per day plant for Pan American Refining Corp. at Texas City, Tex. Lummus Co. is building the El Dorado unit, and M. W. Kellogg Co. has the construction contracts for the other two units.

The Indiana companies have been identified with catalytic reforming since its origin. The first fixed-bed Hydroformer employing a molybdenum catalyst was completed at Pan American's Texas City refinery in 1941, and a second unit was added soon after at Whiting. The group also pioneered in commercial application of the Fluid Hydroforming process with the first unit recently completed at Pan-Am Southern's Destrehan refinery. This process is a joint development of Indiana, Standard Oil Co. (N.J.), and M. W. Kellogg Co. A 30,000-bbl. per day unit is now under construction at Whiting.

Completion of all projects now contracted will bring the Indiana Standard companies' total catalytic reforming capacity comprising three processes at 5 refineries to about 100,000 bbl. per day.

Industry Affairs

T.G.T. Expanding

Company to hike capacity to 2.1 billion cubic feet

HOUSTON.—Tennessee Gas Transmission Co. is planning a $45,000,000 expansion of its system which will raise delivery capacity to 2.1 billion cubic feet daily.

Major expenditure will be for construction of 243 miles of 24-in. line from northern Pennsylvania to the outskirts of New York City.

The line will extend from Tennessee's trunk line at Hebron storage field in Pennsylvania to near Greenwich, Conn., where it will connect with the system of Tennessee's subsidiary, Northeastern Gas Transmission Co.

The new 24-in. would complete a 1,000-mile loop through New York, New Jersey, Pennsylvania, and New England on the delivery end of Tennessee's trunk system from the Gulf Coast. The loop would begin and end at the Ohio-Pennsylvania state line near Mercer, Pa. This, together with the planned development of additional underground-storage facilities, will boost delivery capacity by about 130,100,000 cu. ft. daily and greatly increase delivery flexibility, according to Gardiner Symonds, Tennessee president.

The company has filed an application with the Federal Power Commission in Washington for permission to go ahead with the project.

Storage expansion . . . Tennessee recently began using the huge Hebron storage field in Pennsylvania. Added

capacity in four more storage fields which the company last week asked FPC to permit it to develop and operate jointly with other companies would boost Tennessee's total underground-storage capacity to 77 billion cubic feet. The company proposed that it be allowed to:

1. Acquire an interest in Colden field near Buffalo, N. Y., and develop it jointly with Iroquois Gas Corp.

2. Acquire and develop Harrison field in Potter County, Pennsylvania, and to acquire for future development Ellisburg field in Potter County and State Line field on the New York-Pennsylvania state line—all jointly with New York State Natural Gas Corp.

Lakehead Testing

Final weld in biggest U. S. crude line made November 2; Alberta oil to reach Sarnia refineries in 2 to 3 weeks

SUPERIOR, Wis.—The final weld has been made in Lakehead Pipe Line Co.'s 645-mile, 30-in. crude line from Superior to Sarnia, Ont.

The entire line is now undergoing extensive tests, and it is expected that oil will reach Sarnia in about 2 or 3 weeks, according to T. S. Johnson, president of Interprovincial Pipe Line Co., parent firm of Lakehead.

Water is being pumped into the line and held under pressure in each section for about 12 hours. Crude oil from Superior is being pumped into the line following the water.

Actual construction of the $75,000,000 line was completed in 5 months—making the project one of the fastest major construction jobs in pipe-line history.

The line, actually an extension of Interprovincial's 1,120-mile Edmonton, Alta.-to-Superior trunk, is the first crude-oil artery in the United States with a diameter as large as 30-in. The combined Interprovincial and Lakehead system stretches 1,765 miles, making it the longest continuous crude-oil main line in the world.

Year-round delivery . . . By insuring steady year-round deliveries, the new line will remove the bottleneck at Superior, resulting from the 5-month winter interruption in Superior-Sarnia tanker movements. The project thus is regarded as a vital defense measure, both in the United States and Canada.

The initial pump station at Superior will be able to pump 120,000 bbl. of crude daily to Sarnia. Capacity ultimately will be increased to 300,000 bbl. daily through the construction of five additional stations.

Construction . . . Route of the Lakehead line runs generally east from Superior across the upper peninsula of Michigan to the Straits of Mackinac, southeast across the lower peninsula of Michigan through Bay City, Saginaw and Port Huron, and across the St. Clair River to Sarnia.

Construction work was slowed by frequent rains on the upper peninsula and by numerous problems encountered in "Little Holland" between Bay City and Port Huron on the lower peninsula where the water table is high and many deep drainage canals had to be crossed. Further north a large part of the line crosses Michigan's vacation land where heavy tourist traffic also hampered operations.

Engineering and management of the project was handled by Bechtel Corp., as agent for Lakehead, under the direction of Van W. Rosendahl, senior vice president, and Clark Rankin, project manager. The undertaking was directed by a coordinating committee headed by R. E. Trammell, vice president and general manager of Interprovincial and Lakehead. Other members included: F. J. Stubbs, assistant general manager, and Roger Clute, chief engineer, both of Interprovincial and Lakehead; Rosendahl and R. L. Hamilton, pipe-line consultant, both of Bechtel Corp.

Main-line contractors were: Mahoney Contracting Co., Anderson Brothers Corp. (two spreads), Midwestern Constructors, Inc., Bechtel Corp., and Conyes Construction Co. (two spreads).

Engineering feat . . . The most spectacular part of the project was the successful crossing of the Mackinac Straits between Lake Huron and Lake Michigan. This was the deepest and one of the most costly underwater pipe-line crossings ever attempted. It involved laying two 21,000-ft. 20-in. lines under the straits at depths below 230 ft. *(The Oil and Gas Journal, August 3, page 34, and September 21, page 168).*

Pipe was welded and coated in 2,500-ft. sections prior to the crossing. A huge winch on the south shore in the vicinity of Mackinac City made the pull, with a winch and cable on the north shore maintaining tension. The submerged pipe was held by special snubbing equipment near the shore during tie-in welding of the 2,500-ft. sections.

Cost of the crossing was estimated as high as $8,000,000—more than 10 per cent of Lakehead's total $75,000,000 outlay for the entire project. Contractor for the straits crossing was Merritt, Chapman & Scott Corp. Crossings of the St. Clair and Saginaw rivers were contracted by Comstock Midwestern, Ltd., and W. J. Meagher & Sons, Inc., respectively. Walco Engineering & Construction Co. built the Superior pump station.

Industry Briefs

LONG BEACH.—The third annual instrument short-course, sponsored by the Southern California Meter Association, will be held at Los Angeles Harbor Junior College in Wilmington on November 19-20. Fundamental theories of operation of various types of instruments will be presented in general sessions. In addition there will be 2 days of class sessions devoted to theory and shop work on temperature measuring devices using electronic circuits.

CALGARY, Ont. — Universal Oil Products Co., Chicago, has licensed Royalite Products, Ltd., to use U.O.P. fluid catalytic cracking process, catalytic polymerization process and gas concentration units at the new 5,000-bbl. daily refinery now under construction at Kamloops, B. C.

TORONTO, Ont. — Trinidad Leaseholds, Ltd., plans to add a $1,000,000 catalytic cracking unit to its Fort Credit, Ont., refinery, officials of the company announced recently. The new unit is expected to be in operation by June 1954.

MONTREAL, Que.—Canadian Petrofina, Ltd., has signed a contract with Houdry Process Corp., Philadelphia, for the licensing of a 20,000-bbl. per day Houdriflow catalytic cracking unit to be constructed at the company's new Montreal plant. The 25,000-bbl. per day refinery to be built by the Belgian interests through their Canadian affiliate, will process imported crudes from South America and the Middle East.

CORPUS CHRISTI.—Construction will start in about 60 days on a new 10-story, $1,000,000 office building by Petroleum Building of Corpus Christi, Inc. Oil-industry firms will be principal tenants in the glass-walled structure, which will have about 60,000 sq. ft. of rental space.

Tax Law in Mill

Revised revenue code due for Congress in February

WASHINGTON. — An all-new tax bill, the first complete writing of the revenue law in many decades, is expected to be ready for action by Congress early next February.

The bill is being written by the staff of the Joint Congressional Committee on Internal Revenue Taxation after study of proposals presented by businessmen and others during hearings last session. The Treasury's ideas for tax changes are now being discussed with the congressional staff.

For years it has been the practice for Congress to deal with tax changes by amending the law. Changes have piled on changes to the extent that it now is difficult to reconcile many confusing provisions. It is the purpose of Congress now to enact a "clean" law in which the administrative provisions will be clarified.

Before the bill is sent to the House floor it will be the subject of further hearings by the ways and means committee, at which a number of basic changes will be considered.

Among the changes to be urged upon the committee are the elimination of double taxation upon corporate dividends, repeal of many present excise taxes on the necessities of modern life —not necessarily gasoline; taxation of cooperative and other business organizations which are now exempt, the adoption of a tax ceiling on individual and corporate income taxes, which would require a constitutional amendment, and the already hotly contested national manufacturers' excise tax.

Import Curb Outlined

WASHINGTON.—Unless Congress acts, the "escape clause" of this country's reciprocal trade agreement with Venezuela offers the only way domestic oil producers can secure any limitation on oil imports.

In reply to urging from J. E. Mowinkle, San Antonio oil producer, that an embargo on imports be invoked, Loring K. Macy, director of the foreign commerce bureau, explained the Secretary of Commerce has no such authority. Macy pointed out that such action would require action from Congress "unless action were to be taken by the White House on the recommendation of the Tariff Commission."

"Maintenance of the present tariff status on petroleum is assured under the

WATCHING WASHINGTON

Bertram F. Linz

Refining Safety Record

Manufacturers of explosives made an enviable record last year of only 3.4 disabling injuries per million employe hours worked, in contrast with a figure of 92.1 per million hours in the logging industry. Petroleum refiners didn't do too badly with an average of 7.9 per million hours.

The figures, gathered by the Bureau of Labor Statistics, reveal that the injury-frequency rate in refineries was up a half point from the average of 7.4 per million hours recorded for 1951. Even so it was little more than half the rate of injury for all manufacturing industry of 14.3 per million hours last year and 15.5 per million hours the year before.

The statistics show that the more hazardous industries apparently are more safety conscious than those which are generally considered "safe." Although the injury rate for the chemical industry was above that for oil refining, 10.1 per million man hours last year, it was well below the all-industry average and represented a substantial improvement over the 1951 rate of 11.5 per million hours.

Some branches of the chemical industry, like explosives, had very low injury rates. Synthetic rubber, although up a full point from 1951, averaged only 3.3 disabling injuries per million hours. Industrial inorganic chemicals had a rate of 8 per million hours, compared with 9.5 in 1951.

Federal Fee Boost Coming

Oil operators holding leases on the public lands may be faced with increased charges for services received from the government.

Instructions have been issued by Joseph M. Dodge, director of the Budget Bureau, to all government agencies "to provide a system of fair and equitable fees which, taking account of the value to the recipient and the public policy or interest served, shall recover, to the full extent possible, the aggregate cost incurred in the conduct of these activities."

No compete record ever has been compiled, but the Budget Bureau estimates the government is spending about $50,000,000 a year on licensing activities from which it derives approximately $20,000,000 a year in fees.

Although the bureau listed the certificates of public convenience and necessity issued by the Federal Power Commission as one of the types of licenses on which the government takes a loss, it did not mention oil and gas permits and leases specifically. Interior Secretary Douglas McKay is expected to take a look at that situation and determine whether operators are paying a fair rate.

The matter of charges for government services received the attention of Congress a couple of years ago when lawmakers wrote into law their belief that all licensing and other government services should be self-sustaining.

Natural Gasoline Squeeze

Natural gasoline operators are complaining they are caught in a serious squeeze between state conservation requirements for high-level operations and the general over-supply situation of the oil industry.

Stocks of natural gasoline have been piling up at the processing plants since last spring and many operators face a saturation of storage facilities.

Natural gasoline accounts for something like 10 per cent of total oil production. Its major market has been among refineries blending it in automotive gasoline but modern refining methods use less of it than did older methods.

Offerings are being made to refineries at considerably less than the publicly announced price, but many refineries already have stocks sufficient for their needs.

So far nobody has come up with any suggestions for meeting the situation. But if as many as 75 per cent of the refineries took as little as 1 per cent more natural gasoline, the problem would work itself out. Refiners say that 1 per cent additional would not be economic in the present circumstances.

present agreement with Venezuela but the concession is subject to the so-called escape clause," Macy said. "It would be appropriate for the independent petroleum producers, individually or as a group, to request the Tariff Commission to institute an investigation."

FTC Shuns Case

Commission opposes second look at Detroit decision

WASHINGTON.—The Federal Trade Commission last week declined to take a new look at the 13-year-old "Detroit" price discrimination case against Standard Oil Co. (Ind.)

The commission told the Seventh Circuit of Appeals in Chicago that the issue in the case is not whether good faith is a defense to price discrimination charges, but whether Standard actually acted in good faith in making the discriminations.

The commission, in opposing a motion by Standard to have the case remanded to the FTC for further consideration, said there has been no change in the commission's position on the case. Standard has contended that the case should be remanded because the present majority on the commission holds a different view on "good faith" than the past administration.

The commission believes Standard's view would open a "floodgate" of applications for reconsideration of other outstanding orders if it is upheld.

Commissioner Lowell Mason, in a letter to the court, declared the case should be remanded on procedural grounds. He said the commission resorted to "unprecedented" means not sanctioned by the Clayton Act when it certified its revised findings and its order directly to the Appellate Court last March.

The case was initiated in 1940 by the commission with charges that Standard had violated the Robinson-Patman Act in granting lower prices to certain of its customers in the Detroit area than were posted to other customers in the same buying class. Standard protested it granted the lower prices in good faith to meet equally low prices of competitors. The Circuit Court modified the commission's order in 1949 and the Supreme Court sent the order back to the commission in 1951 ruling that good faith was an adequate defense to the charges.

The commission last week told the Circuit Court the question of good faith as a defense, is not at issue since the Supreme Court decision. "Absolute evidence" that the price was established to meet competition is now the issue, according to the commission.

WEST COAST

Gloomy Outlook Scored

Moody tells West Coast geologists old fields are far from depleted, urges bolder wildcats to find new fields

D. H. Stormont

LOS ANGELES.—Although California ultimately will face a future characterized by declining oil production, its older fields will continue to surprise those who forecast their early decline to "senility."

This was the conclusion drawn by Graham B. Moody, chief reserves engineer for Standard Oil Co. of California, in an address before the Pacific Section of the American Association of Petroleum Geologists at its annual meeting here November 5-6.

He acknowledged the recent low rate of "new field" wildcat discoveries, but took exception to many recent statements to the effect that, "We are headed definitely to a drouth with respect to crude oil, and a gloomy outlook for California's oil industry."

The older fields, particularly the 33 which fall in the 100-million-barrel class, have been the backbone of the state's production over a long period of years, he declared. The industry in the past has failed to recognize the full potentialities and importance of its largest fields. And, he added, it seems probable that, "We do not realize yet how much oil will be recovered ultimately from them."

Basis of study . . . Moody's conclusions were based on studies of oil discoveries in which he credited later new-pool discoveries to the original "new field" discovery with which they were associated. He likewise evaluated the old fields on the basis of their known performance; i.e., all subsequent extensions and revisions were credited to the year of the field's discovery.

Viewed in this light, charts presented showed that California's most successful exploratory effort occurred between 1915 and 1924 and centered in 1920. During this "physiographical" cycle 12 big fields were discovered. They accounted for 5 billion barrels of oil, or about 36 per cent of that found to date in California.

Prior to this period, drilling on surface-reflected structures had uncovered 11 of the 33 major fields. Since then deeper drilling and geophysical cycles accounted for the remaining 10 big fields. Only two have been found since 1941.

Further stressing the importance of the 33 "big wheels," Moody stated they account for 82 per cent of all crude discovered to date. They contain more than 78 per cent of all remaining proved reserves, and in spite of their age will account for 72 per cent of the state's 1953 oil production.

Peak reserves potential was reached in 1938, he said. Although it was not realized at the time that this amount was recoverable, the state's reserves then were 6.25 billion barrels. He estimated current reserves at slightly more than 4 billion barrels.

How to find big fields . . . Similar large new fields will not be found by continued search on or near proved structures, Moody declared, pointing out that most of the recent exploratory drilling was along these lines.

Operators should quit "nibbling" around the skirts of old producing areas and make bold moves into unproved areas. It is only by such steps that fields like San Ardo and Cuyama Valley—the two major discoveries since 1941—will be found.

Because not enough "new field" wildcats were being drilled, in recent years new small discoveries have fallen far behind the attempt to replace annual withdrawals of crude oil. The total amount of new reserves added since 1941 has been only 1 billion barrels, insufficient when compared with a current annual production of 360,000,000 bbl.

This year's new field and pool discoveries he estimated would be no better than the record of other recent years. But through revisions justified by the performance of old fields, and through extensions, California's new crude reserves will approximately balance withdrawals.

Deep Fishing Continues

BAKERSFIELD.—Ohio Oil Co. was continuing fishing operations in its deep Paloma field test, after stuck pipe halted drilling at 21,482 ft.

With top of the fish at 10,889 ft., effort was being made to free pipe above the safety joint of the core barrel at a depth of 21,450 ft.

Rig Noise Muffled

Traffic sounds drown out drilling in Beverly Hills

LOS ANGELES. — Universal Consolidated Oil Co. has started its deeper-zone test in the old Beverly field on the outskirts of Beverly Hills, using equipment that is the last word in silent drilling.

Drilled on Twentieth Century-Fox studio properties, the well is only a short distance from busy Olympic Boulevard. Because derrick and all power equipment are completely enveloped in a sound-proofing covering, traffic noises drown out drilling sounds to anyone standing on the drill site. To achieve the high degree of muffling, 50 per cent more fiber-glass insulation than has been used heretofore was sandwiched into the fireproof, vinyl-coated covering.

All drilling operations are powered by a.c. motors, using 440-volt current transformed from 34,500 volt at the drill site. Motors range from two 150-hp. units on the draw-works drive to a 350-hp. unit which belt-drives one of two mud pumps.

The test is regarded as having better than average chances of operating a new pay below the present shallow Pliocene producing sand. In 1925 a well was drilled to a depth of 5,084 ft. Although abandoned later because of mechanical failures, the deeper zone produced at a rate in excess of 1,300 bbl. daily on a test.

If 1 Twentieth Century-Fox is successful, additional wells will be slanted from the 200 by 300-ft. drilling island. Spaced at 10-ft. intervals on the surface, some might be bottomed more than ¾-mile away if the 260-acre lease is all productive.

Wells completed will have the surface flow-controls housed in cellars, so there will be no visible evidence the well is there. Dumping would be done by means of hydraulic equipment powered by electric motors. All drilling and producing activities will be conducted in such a manner as not to interfere with the surrounding residential area.

Long Beach Vote Postponed

LONG BEACH. — In order that more study can be devoted to several proposed charter amendments the Long Beach City Council has cancelled the special election set for December 8 and reset it for January 21, 1954.

Expected to be included in the balloting are proposals for changing rules regulating bidding for development contracts, and to permit unitization of city properties with those of oil companies. Several proposals relative to the expenditure of tideland oil funds also will be included.

Long Beach Survey Nearer

LONG BEACH.—Approval by the State Fish & Game Commission for the City of Long Beach to conduct a seismic survey inside the breakwater at San Pedro Bay has moved development of the city's potential offshore reserves a step nearer.

The permit required that work to be performed during December and January. Another requirement is that no shooting be conducted within 1,500 ft. of permanent structures, including the breakwater.

Contract terms with three seismograph companies are being negotiated, City Manager S. E. Vickers stated. It has been estimated cost of the survey will be between $50,000 and $75,000.

ROCKY MOUNTAIN

Coker Contract Let

Fluor will buid Carter's Billings refinery plant

BILLINGS, Mont. — Fluor Corp., Ltd., will build and install the world's first commercial fluid coking unit at Carter Oil Co.'s refinery here.

Contract for the new 3,000-bbl. unit has been let, but actual construction will not begin until spring. I. J. Staid, Carter manager for manufacturing, said, assembling of materials and detailed engineering work will get under way immediately.

The new coking process, designed to increase the output of gasoline, tractor and diesel fuel is the result of 4 years of research and development by Standard Oil Development Co. The unit at Carter's Billings refinery is the first of three such units planned *(The Oil and Gas Journal, August 17, page 74)*.

The process employs an old tool for a new job. The fluidized-solids technique perfected for cat cracking and later used for cat reforming is adapted for the thermal cracking of heavy fuels which cannot economically be cat cracked. The principle is the same except that coke instead of catalyst is the fluidized solid. *(See page 181.)*

Construction of the new coking unit at Billings is the first step in an extensive expansion and improvement program planned by Carter in the northwestern states. An outlay of $4,000,000 is planned for the program with 200 to 300 persons employed on the projects at peak-construction periods.

The Carter coking unit is expected to be completed and in operation by October 1954.

North Dakota Gasser Tested

McHALL, N. D.—The first commercial gas well in 20 years for North Dakota is indicated in tests of a shallow wildcat, the 1 Brudvik, NW SW 21-16n-84w, Renville County.

Total depth of the Leach & Kelsch well is only 303 ft. with tests showing what is apparently commercial gas at 302-303 ft. It is the second test in the area. The first was dry and the Bismarck operator has a third well under way.

The last commercial gas well in the state was more than 20 years ago during the opening of gas production in the southeastern Cedar Creek anticline in Bowman County.

South Dakota Strike Indicated

RAPID CITY, S. D.—Shell Oil Co. reports the first apparent commercial shows in South Dakota at its wildcat, the 1 State A, SW SE 9-21n-4e.

A test of the 9,589-8,604 ft. interval recovered 570 ft. of black, 22.1°-gravity oil, 90 ft. of oil highly cut with mud and gas, and 100 ft. of water cut with oil and gas. Test was in the Red River member of the Ordovician. Another test will be run at the significant well.

The wildcat is on a seismic prospect in the Custer area, about 30 miles southeast of production in the Ordovician at Little Beaver field, Fallon County, Montana, and is about 75 miles south of nearest production in North Dakota at the recent Fryburg discovery in Billings County. The apparent Harding County discovery is about 6 miles northeast of a recent Carter Oil Co. wildcat which had slight shows in the Red River.

START OF DRILLING was marked by a visit from Australian government officials. A. R. G. Hawke, Premier of Western Australia, left, and State Minister for Mines Kelly offer W. G. Walkley, managing director of Ampol Petroleum, their best wishes.

TOPPED by both American and Australian flags, the 142-ft. derrick of the drilling rig stands out against the stony hills of Rough Range at Exmouth Gulf, a desolate location almost 600 miles north of Perth, in Western Australia.

Wildcat Going Down

Australian company starts drilling on first expensive test well planned for 45,000-sq. mile North-West basin

A DETERMINED bid to find oil in Australia is being made at Exmouth Gulf, 700 miles from Perth, western Australia, where drilling began in September.

In the 45,000-sq. mile North-West basin, surface evidence and seismic surveys have revealed the existence of several structures. The operating company is West Australian Petroleum Pty. Ltd., financed by Ampol Petroleum, Ltd., an Australian oil distributing company, with 20 per cent of the shares, and Caltex, which holds the remaining 80 per cent.

During the war Exmouth Gulf was a base for American submarines, and Australian troops set up a radar station for mounted antiaircraft guns. The Royal Australian Air Force built an aerodrome at Learmouth, 15 miles northeast of the well site.

Ampol has been interested in the area since 1946, but not until Caltex came into the picture 2 years ago was sufficient financing available for drilling. Surveys have been carried out by Australia's Bureau of Mineral Resources since 1948. The results were made available to Ampol.

Drilling costs . . . It is estimated that the sinking of the first test well will cost £A1,000,000 ($2,250,000). Since 1951 about £A1,500,000 ($3,375,000) has been spent, with another £A675,000 ($1,518,750) earmarked for 1953. Keeping a party of 108 men in the field alone costs £A22,000 ($49,500 a month.

Continent-wide surveys by the Bureau of Mineral Resources have indicated the most likely areas to find oil in Australia are the large marine sedimentary basins in western Australia—the North-West basin, and the Fitzroy and adjacent Desert basin. This latter area, over which West Australian Petroleum Pty. Ltd., also has exploratory leases, is in the Kimberley region, 800 miles further northwest.

Attention has been focused on the North-West basin, considered to have many structures worth testing despite the fact no seepages or oil traces in water wells have been found. Much of the section is Permian.

Geological surveys . . . The Bureau of Mineral Resources has made detailed geological surveys of three separate structures. One, the rugged and broken Cape Range, rises on the shores of the Indian Ocean and runs 60 miles north to the tip of the peninsula separating the ocean from Exmouth Gulf. But it has proved too difficult to survey by seismic methods.

To the southwest is another long, low feature called the Giralia-Cardabia structure, after two sparsely stocked sheep ranches in the vicinity. However, this anticline does not continue at depth. Between these two structures is a third, Rough Range, where the drilling is now under way. Possibilities of this site were first indicated by the bureau, which ran an east-west traverse from the Giralia region to the Cape Range. In 1952 and early 1953 West Australian Petroleum carried out a second traverse and pinpointed the location.

West Australian Petroleum also has a survey party at work in the Fitzroy basin, where the Bureau of Mineral Re-

STRANGE PETS for the drilling crew are just another novelty involved in drilling for oil 600 miles in the interior of Australia in a region that is virtually uninhabited. Al Dystart, left, chief driller from Long Beach, shows his pet kangaroo to Charles Henright, rig engineer from Bakersfield.

sources found surface indications which appear as good as in the North-West basin.

Equipment . . . The modern drilling equipment being used was imported by the company landed on the shores of the gulf. A National drilling rig was shipped in sections across the Pacific, transferred to lighters in the shallow gulf, then hauled by heavy diesel-driven trucks to Rough Range. Other heavy equipment went overland nearly 1,000 miles, a trip where drivers had to contend with boggy tracks, flooded watercourses, and blinding dust. In March 1953 the base camp at Learmouth was hit by a cyclone which flattened buildings and tore up foundations. In the summer, temperatures in the region rise to as high as 117° F.

Oil Law Drafted

Turkey's leaders expect passage of new act by '54

TURKISH Government officials are now readying the draft of a new petroleum law which will be presented in the near future to the current session of the Grand National Assembly.

Max W. Ball, Washington consultant, and Elmer E. Batzell, Washington attorney, arrived recently in Ankara with a draft of the legislation which they prepared at the government's request. A Turkish Embassy announcement said the government anticipates enactment of the law by the end of the year.

The Ball-Batzell draft includes a statement of national oil policy declaring it to be Turkey's objective "to further and bring about through private initiative and investment, domestic or foreign, the production and transportation of petroleum, and the manufacture, transportation, distribution, and use of petroleum products."

Reports in the industry are that the draft calls for long-term exploration and development permits. Exploration licenses would have a 5-year initial period with yearly extensions available, while development concessions would carry a 50-year term.

Operators would pay a royalty of around 10 per cent and would be allowed a 27½ per cent depletion allowance. The ceiling on acreage will be high enough not to deter interested companies.

International Briefs

One of the world's largest tankers, the Tina Onassis of 45,720 tons deadweight, left Hamburg, Germany, recently on its trial voyage to Bremenhaven. The giant vessel, built by the Howaldt shipyards in Hamburg for the Greek operator, Aristoteles Onassis, is scheduled to be delivered this month. The ship has a length of 775 ft. overall and developes a speed of 16 knots.

Creole Petroleum Corp.'s operated production in September averaged 693,092 bbl. daily, up 22,763 bbl. daily from the previous month. The increase was the first monthly gain in 5 months. During September, Creole operated a total of 21.7 rigs, unchanged from August, and completed 10 wells. Refinery runs averaged 144,608 bbl. daily, including 63,620 bbl. daily at Caripito and 80,988 bbl. daily at Amuy.

Two southwestern independents, M. B. Rudman and William G. Helis, are making plans to enter exploratory work in Italy and Sicily. It was announced in Dallas, headquarters of the Rudman interests, that Rudman has held conferences on the matter in Rome with James Rorison, drilling and production superintendent for Helis. The Helis firm, of New Orleans, has been exploring in Greece for some time and now has an exploratory well under way.

The Iraq Government Development Board has awarded a contract for the construction of an asphalt plant at Qaiyarah in northern Iraq to the Lummus Co., Ltd. The project involves an outlay of about $3,300,000. The development board handles the expenditure of a large part of the oil royalties received by Iraq.

The first deep test in the Paris basin in northern France has been drilled to 2,015 m. (6,600 ft.) at a location 3½ miles north-northwest of Verdun by the French company, Regie Autonome des Petroles. The well, Vacherauville 1, was completed dry.

The King Is Dead . . . Son Ascends Throne

IBN SAUD

EMIR SAUD

KING IBN SAUD of Saudi Arabia, who granted the original Arabian oil concessions to Standard Oil Co. of California in 1933, died last week at his summer palace at Taif, southeast of Mecca.

The eldest son of the last absolute monarch in the world, Crown Prince Saud, is the new king. His elevation to the throne will have little or no effect on the operations of Arabian American Oil Co., which contributes an estimated $200,000,000 annually to the kingdom in oil royalties.

The new king, Emir Saud, is "well disposed toward Americans" and is expected to relax some of the feudal restraints and isolation of his country. The most widely traveled of the Arabian royal family, the new king is more liberal in his regard for western civilization and customs than was his father, the 6-ft.-4 warrior who welded Saudi Arabia into a Moslem kingdom with his sword.

Negotiations over revisions of Aramco's concession contract, suspended after the old king became ill, are now expected to be resumed. Saudi Arabia is asking further modifications which would add to its income. The first 50-50 profit-sharing agreement in the Middle East was signed with Aramco by the wily old king in 1950.

PERSONALS

New A.P.I. Chairman

P. C. Spencer, president of Sinclair, succeeds Wescoat

THE top "idea man" for Sinclair Oil Corp. last week moved into chairmanship of the American Petroleum Institute's board of directors backed by reputation for devising new and better ways to get things done.

P. C. Spencer, with 31 years in the oil industry behind him—4 of those years at the helm of Sinclair—succeeds L. S. Wescoat as board chairman.

He became head of Sinclair Oil early in 1949 when H. F. Sinclair, president of the associated companies for 33 years, relinquished active direction of operations and became chairman of the board.

Since that time, Spencer's "ideas" have appeared in a number of ways within the company operations. He has promoted company research and expanded the program to inaugurate a plan by which Sinclair offers testing and laboratory facilities to independent inventors. His 5-year program for development of company-owned production has increased Sinclair production from an average of 89,000 bbl. daily in 1949 to 119,000 bbl. daily in the first 9 months of this year in spite of proration cutbacks.

Spencer set up within the company a "junior board of directors" under which young Sinclair executives are trained by assignment to study phases of the business and assist the company's regular directors.

The company's chief executive keeps regular hours in a well-appointed office in Sinclair's modern building at 600 Fifth Ave. in New York City, and usually carries home a brief case filled with more work at the end of the day—this, when he isn't flying across the country in a converted company DC-3 visiting company installations.

Spencer is an amateur horticulturist who grows flowers, specializing in dahlias at his home in Scarsdale, N. Y.

A native of New York, he was graduated from the University of Nebraska law school in 1916 and saw 2 years' service in the army in the first World War. He followed his military duty with 2 years in Washington as secretary to the late Sen. Francis E. Warren of Wyoming. He practiced law in Cheyenne from 1922 to 1928 and served as state chairman of the Republican state central committee during this period.

It was during this era of Spencer's life that he first became associated with the oil industry. He joined Producers & Refiners Corp. in 1922 as legal counsel and later became general counsel for the company and its subsidiaries. He became active in the Sinclair organization when it acquired the Prairie companies, of which Producers & Refiners was a subsidiary.

Spencer moved to New York as a member of Sinclair's legal department in 1934 and in 1946 became general counsel of Sinclair Oil and a year later he was president of Sinclair Refining Co. It was in 1948 that he became executive president of Sinclair Oil and a year later that he took over the helm of the Sinclair operations.

W. George Knollenberg, formerly an engineer with Stone & Webster Service Corp. at Owensboro, Ky., has joined Central Indiana Gas Co. as engineer and superintendent of operations at Marion, Ind.

J. E. Teddlie, Jr., district production superintendent for Herman & George R. Brown, has been transferred from Midland, Tex., to Oklahoma City.

Keith Miller has been promoted by Standard Oil Co. of California from traffic representative in Seattle to assistant manager of the firm's traffic department in San Francisco. He succeeds **F. G. Beutler,** who has retired after 42 years with the company. Beutler joined the firm in 1911 and was traffic representative in Seattle from 1948 to 1950, when he was transferred to San Francisco as assistant manager of the department. Miller has been with Standard since 1927 and joined the traffic department in 1941.

Richard R. Evans, engineer with Sunray Oil Corp., has been transferred from Premont, Tex., to Tulsa.

J. Ed Warren, former deputy administrator of the Petroleum Administration for Defense, has joined the National City Bank of New York as petroleum consultant. He is a past president of the Independent Petroleum Association of America and of the American Association of Oil Well Drilling Contractors, and a member of the American Association of Petroleum Geologists, the National Petroleum Council, American Institute of Mining and Metallurgical Engineers, and American Petroleum Institute.

Stewart Cronin has been promoted by Pure Oil Co. to assistant division manager of the southwestern producing division at Tulsa. He had been manager of division exploration activities since 1950. He joined Pure in 1933.

Eugene J. Haug has joined the staff of the American Petroleum Institute as engineer in the Division of Refining. His work will be concerned primarily with projects of the committee on refinery equipment. For the past 2 years he has been in business for himself designing specialty equipment for use in catalytic cracking operations. Haug was project engineer and project manager for Arthur G. McKee Co. from 1946 to 1950. During 1951 he was project engineer with Lummus Co., working on a variety of refinery design and construction problems with emphasis on fluid catalytic cracking units.

George W. Marshall, Jr., has been promoted by Continental Oil Co. from division geologist at Roswell, N. Mex., to the newly created position of assistant regional geologist for the company's southwestern area. His headquarters are in Fort Worth. **G. H. Galny,** assistant to the southwestern regional geologist, has been transferred from Fort Worth to Roswell to replace Marshall as division geologist. **J. B. Brown,** Fort Worth, has been promoted to succeed Galny.

PERSONALS

Don O. Hickman, production foreman for Carter Oil Co., has been transferred from Mattoon, Ill., to Sullivan, Ind.

Thomas A. Aldridge, Baltimore, has been appointed a vice president by American Oil Co. He will supervise four executive staff departments and handle special assignments. Aldridge joined the company in 1933 and had been director of industrial relations since November 1950.

Harry D. Younkman, senior geologist for Sinclair Oil & Gas Co. at Tulsa, has retired after 10½ years with the firm. He has been an active geologist for over 40 years and was a member of Carter Oil Co.'s original geological department when it was established in 1916. He also has been associated with several other oil companies.

H. A. Metzger will join Creole Petroleum Corp. on March 1, 1954, and will be in charge of the firm's New York office. He will replace **C. L. Burrill,** vice president and director, who will resign at that time to become head of the general economics department of Standard Oil Co. (N. J.). Metzger's entire career has been in South America where he has he'd various positions in affiliates of Jersey Standard, particularly in Colombia, Boliva, and Argentina. He has been president and general manager of the company's Argentine affiliate since 1944. Burrill's department will follow and analyze trends in general business and economic conditions on a world-wide basis and also serve in an advisory capacity on general economic matters for Jersey and affiliated companies. Another New Jersey department for coordination and petroleum economics, headed by **J. A. Cogan,** will conduct world-wide supply and demand surveys, prepare special studies and economic analyses of petroleum problems, and assemble statistics.

Jim Sublette, petroleum engineer with Gulf Oil Corp., has been transferred from Tulsa to Centralia, Ill.

P. F. Williams, engineer formerly with Venezuelan Atlantic Refining Co. at Caracas, Venezuela, has joined Gulf Interstate Gas Co. at Houston.

Vaughn S. Moyer, formerly staff engineer for Union Oil Co. at Bakersfield, Calif., has been promoted to southern division petroleum engineer at Santa Fe Springs, Calif.

A. R. Simpson, process design engineer formerly with Republic Oil Refining Co. at Texas City, Tex., has joined H. K. Ferguson Co., Houston.

Jim Myers, formerly pipe liner at Salem, Ill., has been promoted to field gager for Sohio Petroleum Co.'s Dudley district at Clay City, Ill.

F. M. Lavender, Fort Worth, has been made division communications supervisor in the southern pipe-line division of Gulf Refining Co. He replaces **M. B. Ownby,** who has retired after being with the firm 33 years. Ownby joined the firm at Houston and was transferred to Fort Worth in 1940. Lavender has been with Gulf since 1933 and at Fort Worth since 1952.

R.M.O.G.A. Elects New Officers for 1954

New officers elected by the Rocky Mountain Oil and Gas Association at its annual convention held recently in Denver are, left to right: R. S. Shannon, Jr., Pioneer Oil Corp., Denver, vice president for Colorado and Nebraska; W. M. Saxon, Pure Oil Co., Billings, vice president for Montana and South Dakota; W. W. (Bill) Flenniken, independent operator, Denver, president; J. L. (Mike) Dougan, Salt Lake City, vice president for Utah; and H. A. (Dave) True, Jr., True & Brown, Casper, treasurer. C. L. Larson, Jr., Stanolind Oil & Gas Co., Casper, vice president for Wyoming, is not shown.

Sam C. Oliphant, Houston, and **James Nash,** Wichita Falls, Tex., have been named vice presidents of Tennessee Production Co., an affiliate of Tennessee Gas Transmission Co. Oliphant joined Tennessee in January as director

S. C. OLIPHANT

JAMES NASH

of geology and engineering. He had been with Stanolind Oil & Gas Co. since 1941 and was made assistant division superintendent of the Gulf Coast in 1948. Nash will be in charge of the firm's northern division at Wichita Falls which includes properties in northern and western Texas and in Oklahoma. He was with Shell Oil Co. in Tulsa as a geologist from 1933-36 and from 1937-41 was with Carter Oil Co. He joined Reno Oil Co. at Wichita Falls as western manager in 1941 and was elected vice president in 1950. Tennessee Production recently purchased Reno's properties.

L. E. Reilly, formerly with Donnally Seismograph Co. at Seagraves, Tex., has joined Chevron Oil Co. as a party chief.

W. D. Sublett has been promoted by Sinclair Pipe Line Co. from station engineer at Marietta, Okla., to field gager at Shidler, Okla.

Dr. Courtney C. Brown, now assistant to the chairman of the board of Standard Oil Co. (N. J.), has been appointed dean of the Graduate School of Business of Columbia University in New York. He will assume his new duties February 1.

Walter R. Mitchell has been named executive vice president of National Geophysical Co., Dallas. He was formerly vice president in charge of research and has been with the firm since 1936. Other promotions include **Paul Farren,** with National since 1937 as computer, party chief, and supervisor, to vice president, and **James H. Frasher** to assistant vice president. Frasher joined the company in 1946 and prior to his present appointment was assist-

PERSONALS

Stanolind Holds Seminar on Reservoir Engineering

A 5-week advanced seminar in petroleum engineering is currently being conducted in Tulsa by Stanolind Oil & Gas Co. for engineers from district offices in its 13-state operating territory. Dr. S. J. Pirson, extreme left, recognized authority on reservoir engineering and a special research associate at Stanolind, is conducting the seminar. Guest lecturers from the company's research center and exploration and producing departments supplement the seminar program. Others pictured are, left to right, K. D. McPeters, Lubbock; J. E. Thomas, Midland; J. D. O'Bryan, Jr., Corpus Christi; and J. P. Campbell, Lake Charles, La.

ant vice president of National's Canadian subsidiary, National Geophysical Co. of Canada.

R. R. Hawkins, formerly manager of water floods for Fullerton Oil Co. at Pasadena, Calif., has been made manager of Waterflood Oil Co. at Fillmore, Calif.

William L. Brown, assistant production foreman, has been transferred by Sinclair Oil & Gas Co. from Carmi, Ill., to Nowata, Okla.

A. W. Vitt, geologist with Seaboard Oil Co. of Delaware at Casper, Wyo., has been elected president of the Wyoming Geological Association. Other new officers include: **Ed Mees,** Continental Oil Co., first vice president; **Roy Heisey,** The Chicago Corp., second vice president; **Charles Rosenthal,** Schlumberger Well Surveying Corp., secretary; and **Don Lawson,** Forest Oil Corp., treasurer.

Guy W. Wadsworth, Jr., has been appointed general manager of Southern Counties Gas Co. of California, Los Angeles. He replaces **Arthur F. Bridge,** who had combined the duties of president and general manager. Bridge will continue as president. Wadsworth, a vice president since 1942, had served as vice president and assistant general manager since 1947. He joined the firm in 1921.

Q. C. Walton, tool pusher for Kerr-McGee Oil Industries, Inc., has been transferred from Riverton, Wyo., to Baker, Mont.

Harold G. Mangelsdorf, manager of East Coast manufacturing operations for Esso Standard Oil Co., has been appointed general manager of the firm's manufacturing department. He succeeds **William Naden,** director and vice president, who has been made primary contact director for the department.

Kazimierz Pochopien, geologist with Union Oil Co. of California, has been transferred from Los Angeles to Bismarck, N. D.

J. W. Wood, Jr., has joined Atlantic Refining Co. at Dallas as junior reservoir engineer.

R. H. Dourson, formerly assistant manager of catalytic cracking at Shell Oil Co.'s refinery at Wilmington, Calif., has been promoted to manager of the experimental laboratory at the company's Wood River, Ill., refinery.

J. W. Arkis has been made group leader in the Wood River, Ill., laboratory of Standard Oil Co. (Ind.). He supervises technical service in connection with manufacturing heavy oils, additives, and chemicals. He has been a project chemical engineer at Standard's Whiting, Ind., research laboratories since joining the company in 1946.

Fred L. Hartley has been appointed manager of a new commercial development division established by Union Oil Co. of California in its research and process department at Brea, Calif. The division has been organized to extend the commercial application and licensing of Union's research and process activities. Hartley has been with Union for 15 years as manufacturing process supervisor in charge of process design and for the past 3 years as general superintendent of operations at Union's Los Angeles refinery.

DEATHS

Norman William McCrae, 58, superintendent of the Imperial Oil, Ltd., refinery at Imperoyal, N. S., for the past year following his transfer from Sarnia, died recently at Halifax. He was superintendent at Sarnia from 1947 to 1952.

Charles W. Cook, 50, active independent oil producer, died recently at Allegan, Mich., following a heart attack.

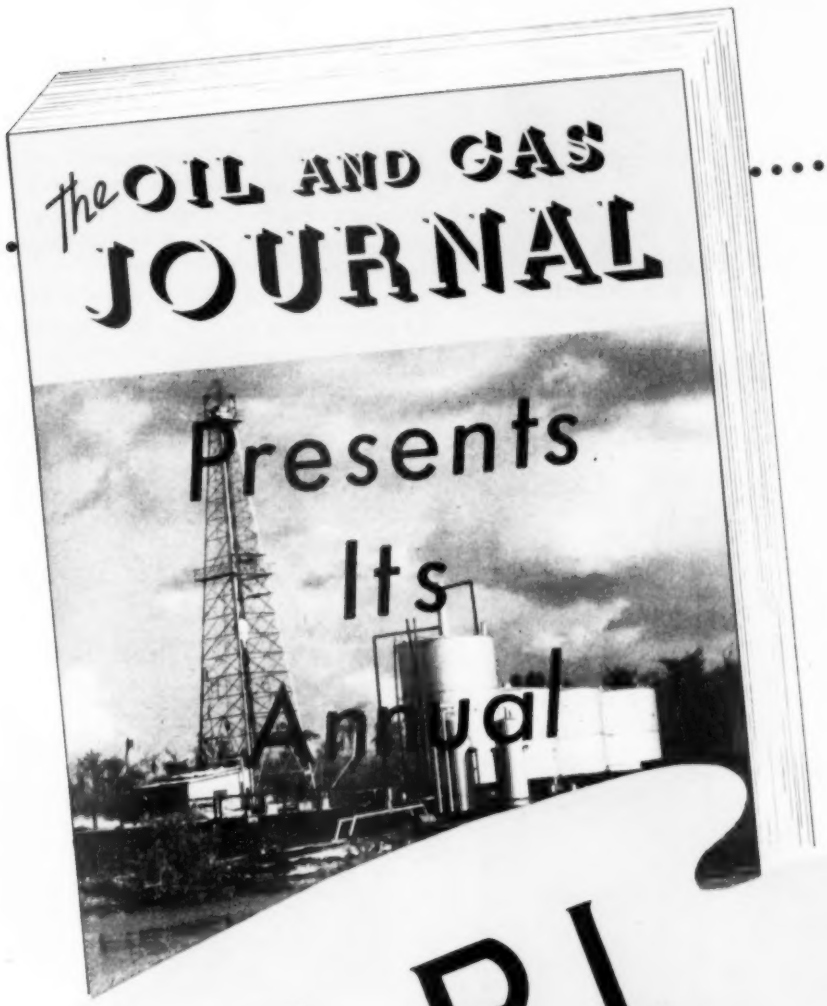
C. O. Maddox, 71, Texas oil man and wildcatter, died recently at McAllen, Tex.

Thomas S. Blair, 55, of New York, was killed recently in the crash of a small airplane near Bunnell, Fla. He was manager of aviation petroleum sales for Swiftlite Aircraft Corp., a subsidiary of Cities Service Oil Co.

Cecil O'Brien, 49, of Amarillo, Tex., was killed recently in an automobile accident near Roswell, N. M. He was president of Nabob Production Co., and had been a director of the Independent Petroleum Association of America since 1947. He also served on the executive committee of the I.P.A.A. from 1947 to 1950.

J. Fred Stephenson, 51, died recently at his home near Andrews, Tex., following a heart attack. He had been with Magnolia Pipe Line Co. for 16 years and was station operator at the time of his death.

... and now



A.P.I. Number

Featuring . . .

The papers of the thirty-third annual meeting of the American Petroleum Institute

Division of Transportation . . .

ANDREW G. ANDERSON
Socony-Vacuum Oil Co., Inc.

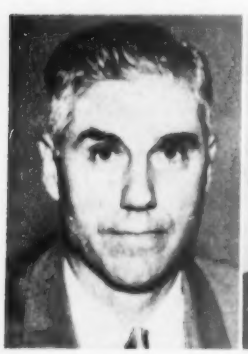
T. E. BUCHANAN
The Texas Co.

CHARLES FITZGERALD
Sinclair Pipe Line Co.

B. B. HOWARD
Standard Oil Co. (N. J.)

GAVIN W. LAURIE
Atlantic Refining Co.

J. P. PATTERSON
Pan American Pet. & Trans.



H. A. RHODES
Transcontinental Gas P. L.

L. S. WRIGHTSMAN
Humble Pipe Line Co.

Industry Honors Awarded To 32 Oil Men

CERTIFICATES of appreciation were presented at Chicago last week at the American Petroleum Institute's thirty-third annual meeting to the men shown on these two pages.

The special awards were in recognition of outstanding service to the petroleum industry in its various fields of activity. The certificates were presented at group sessions on transportation, production, research, marketing, financial and accounting, statistics work, public information, and the American Petroleum Industries Committee.

Marketing . . .

A. L. NICKERSON
Socony-Vacuum Oil Co., Inc.

A. P. I. C. . . .

CYRUS S. GENTRY
Wolverine Pipe Line Co.

Financial and Accounting . . .

L. E. HANSON
Socony-Vacuum Oil Co., Inc.

Statistical Advisory . . .

JOHN W. BOATWRIGHT
Standard Oil Co. (Ind.)

Oil Industry Information Committee . . .

W. CHALMERS BURNS
Hartol Petroleum Corp.

WILLIAM N. FINNIGAN
Humble Oil & Refining Co.

EMMETT M. HOWARD
American Oil Co.

W. J. LOUFMAN
Fleet-Wing Corp.

FRANK V. MARTINEK
Standard Oil Co. (Ind.)

A. T. SMITH
Continental Oil Co.

Research . . .

STUART E. BUCKLEY
Humble Oil & Refining Co.

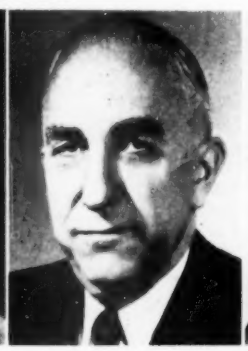
BEN B. COX
Gulf Research & Dev. Co.

L. M. HENDERSON
Pure Oil Co.

WAYNE E. KUHN
The Texas Co.

Division of Production . . .

C. W. ALCORN
Falcon-Seaboard Drilling Co.



GEORGE P. BUNN
Phillips Petroleum Co.

B. R. CARNEY
Warren Petroleum Corp.

J. C. DONNELL, II
Ohio Oil Co.

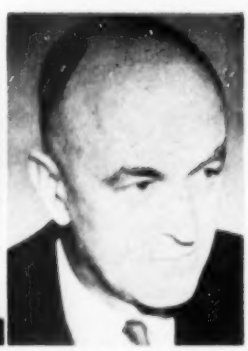
FRANK E. ECKERT
Hanley & Bird

J. G. MONTGOMERY, JR.
United Natural Gas Co.

J. H. NEWLON
Consultant

J. FRENCH ROBINSON
Consolidated Nat. Gas Co.

L. R. SMITH
Tide Water (Deceased)



CHASE E. SUTTON
Pure Oil Co.

Typical equilibrium coke.

A.P.I. SESSION ON REFINING PROCESSES

Continuous-Coking Process Shows Ability to Handle Heavy Feed Stocks

by Valentine Mekler, A. Schutte, and T. T. Whipple

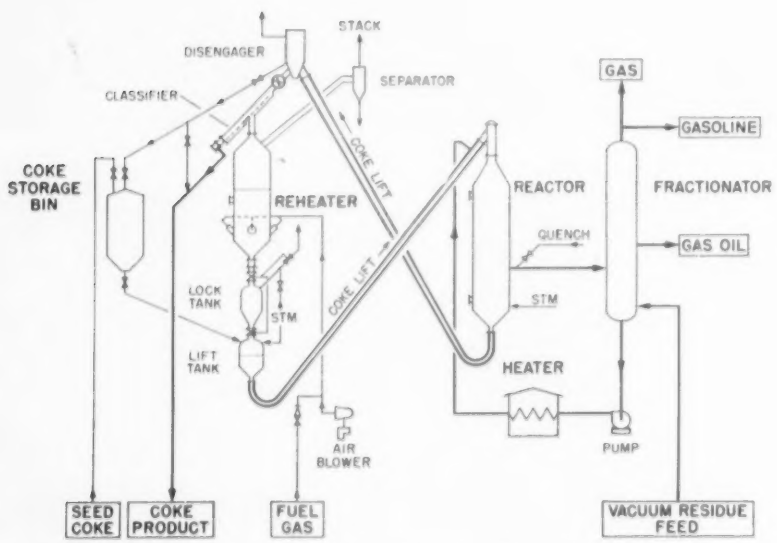


Fig. 1—Simplified flow diagram of 1,000-bbl. per day contact coking unit.

THE continuous-contact coking process has now been tested in commercial operation, and results show that the following advantages accrue from its application:

- Heavier residues than those normally handled by the conventional delayed coking method can be upgraded.
- Flexibility of the process permits processing stocks of widely different characteristics to obtain wider ranges of yields and product specifications.
- Need for intermittent cleaning of coke drums is eliminated.
- Product coke is clean, hard, uniform in size, and easily handled and marketed.
- Capital investment and operating labor for a contact unit are less than for a delayed coking unit.

The first commercial continuous contact coking unit was erected in the McKee refinery of Shamrock Oil & Gas Corp., Sunray, Tex. It was designed to process vacuum-distillation residue from Panhandle crude oil—at a nominal charge rate of 1,000 bbl. per day—for the production of gas, gasoline, gas oil for catalytic cracking feed, and coke.

The unit has been in operation for the past 8 months, during which period yields over a wide range of operating conditions were obtained. The outstanding feature of the unit is its flexibility and ability to handle feed stocks much heavier than normally can be processed by conventional delayed coking.

Data on yields, product specifications, and operating costs are presented herein.

Development . . . The development work on the continuous-contact coking process has been carried out during the past 6 years, and was described in earlier publications.[1 2 3] This work was accomplished with: (1) a laboratory unit; (2) a 50-bbl. per day pilot unit, followed by (3) a 100-bbl. per day semi-commercial unit; and, finally, (4) the commercial unit described in this paper. Yield correlations between laboratory unit and the commercial unit have been established. The laboratory unit now is used to evaluate any stock with reasonable confidence.

Description of Unit

Fig. 1 is a simplified flow diagram of the 1,000-bbl. per day unit.

The unit consists essentially of: (1) a reactor in which the oil-wetted coke particles or "seed" coke flow downward as a dense bed; sufficient time is provided in the reactor for the cracking, coking, and drying reactions; (2) a re-

Authors associated with the Lummus Co., New York. Paper presented before refining division, A.P.I., annual meeting, Chicago, November 9, 1953.

heater in which the circulating coke is raised in temperature to supply the heat of reaction, some sensible heat to the feed, and radiation losses; (3) a coke-circulating system which uses the "mass-flow" principle to elevate the coke as a dense unagitated column; and, (4) a fractionation system for the separation of products.

The vacuum-residue feed is introduced into the bottom of the fractionator, where it is mixed with recycle stock and further preheated in a tubular heater to approximately 700° F. This feed is mixed thoroughly with the hot circulating coke stream. The lighter portions of the feed are vaporized, and the heavier constituents are retained on the coke particles as a liquid film. As the coking reaction proceeds, the film is converted into gas, hydrocarbon vapors, and residual coke, and the latter is retained on the seed particle.

As successive increments of coke are deposited, a gradual increase in coke-particle size occurs. The larger particles, which have a diameter of approximately ½ in. or more, are drawn off continuously as product coke to maintain a nearly constant coke inventory in the system. The vapors from the reactor, at a temperature of 900° to 1,000° F., are quenched and released to the fractionator. From the bottom of the reactor the dried coke is elevated to the disengager by a low-pressure mass lift which is "powered" by the reactor pressure of 35 psig.

The coke from the disengager flows by gravity into the reheater, where it is heated to between 1,000° and 1,100° F. by gas firing or by burning a portion of the coke. The reheated coke is discharged intermittently by gravity into the lock tank, from which it flows into the lift tank to start another cycle of the coke circuit. The energy for circulating the coke is supplied by 150-psig. steam at the lift tank. The sequence of coke flow from the reheater and lock tank is controlled automatically by a cycle timer.

This is the first commercial installation of the "mass-flow lift" developed by Union Oil Co. of California. The coke circulation is continuous and smooth. The rate of flow is controlled by a rotary star valve above the reheater. Only one coke level must be controlled—that of the reheater. The coke-circulation rate may be increased or decreased by varying the speed of the rotary star valve.

The ratio of oil to coke for normal operation is 10 bbl. of oil per day per ton of coke circulation per hour, i.e., 1 lb. of oil per 14 lb. of coke circulated.

The general arrangement of the unit and equipment is shown in Fig. 2. The highest elevation of any equipment is 80 ft. above grade. The reactor and reheater are supported from the third level above grade, with the blower and lift tank on a lower level. The control room is located at grade. Advantage

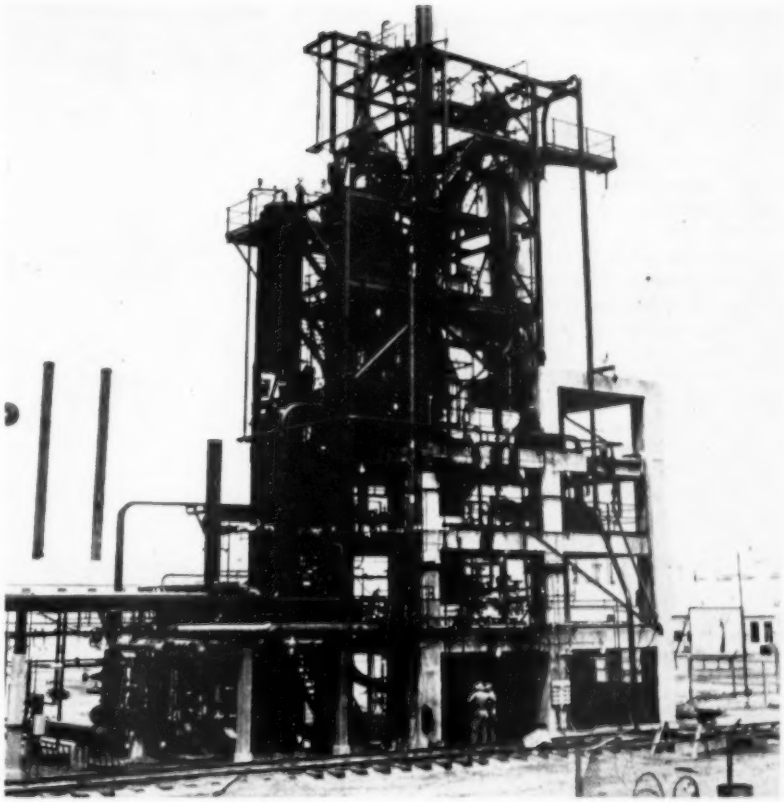


Fig. 2—General view of contact coking unit at plant of Shamrock Oil & Gas Corp., Sunray, Tex.

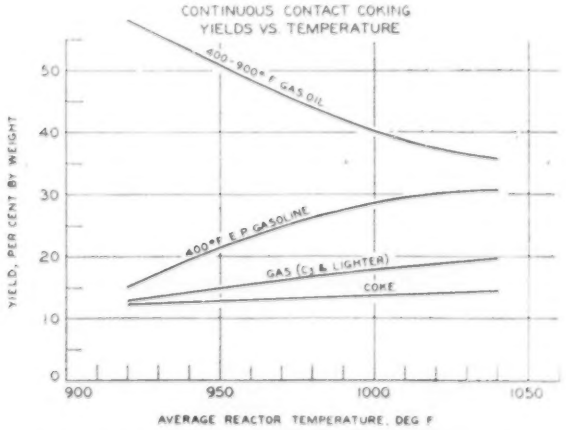


Fig. 3—Correlations of product yields vs. reactor temperature.

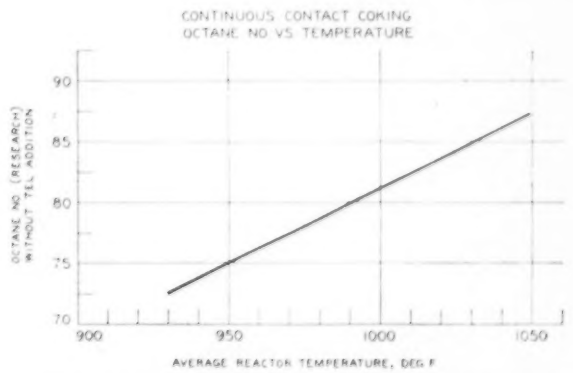


Fig. 4—Correlation of gasoline octane number vs. reactor temperature.

has been taken of the latest developments in automatic instruments for control of the coke-circulating system.

Performance . . . Table 1 presents feed-stock characteristics, operating conditions, yields, and product specifications of a typical run.

The feed stock to the unit was a vacuum-distillation bottoms from Texas Panhandle paraffinic crude oil, and represented approximately 10 per cent on the crude. This is a much heavier charge stock than normally could be processed by a conventional delayed-coking unit.

The products were metered and, wherever possible, tank gages were used. Coke production was determined by difference. Test runs under varying reaction temperatures were made. The unit operated successfully with average reaction temperatures as low as 900° F. and as high as 1,025° F.

Yields for a range of reactor temperatures are presented in Table 2.

TABLE 2—SUMMARY OF YIELDS WITH VARIOUS REACTOR TEMPERATURES

Test No.—	1	2	3	4
Average reactor temperature, °F.	1,025	985	965	955
Yields, per cent by weight—				
C_3 and lighter	18.6	17.1	15.8	14.5
C_4 to 400° F. Gasoline	29.9	27.2	24.0	22.0
Gas oil	37.5	42.2	47.2	51.0
Coke	14.0	13.5	13.0	12.5
Total	100.0	100.0	100.0	100.0
Research octane number, without TEL addition, A.S.T.M. D 908 (research method), corrected to 10 lb. R.v.p.	84.0	80.5	76.6	75.0

From our experience it is apparent that lower operating temperatures are practical, and could be attained by still further preheating of the feed stock to the extent that the heat of vaporization is supplied in a tubular heater and, thus, the coke temperature levels are reduced throughout. A reduction in temperature level will reduce the gas and gasoline production with a corresponding increase in the yield of gas oil.

Fig. 3 presents test-yield curves vs. reaction temperatures. These curves have been plotted from actual data obtained from approximately 50 runs with varying operating conditions. The trend of the curves for each of the products is similar to yields obtained from a delayed coking operation. Compared with delayed coking, the yields from contact coking show considerably lower coke production with higher gas and gasoline yields.

The important point, which is evident from these curves, is that the operating temperature range of a contact coker is much wider than can be obtained with a conventional delayed coker and, likewise, the product yields and specifications can be controlled over a wider range.

TABLE 1—PROPERTIES OF CHARGE STOCK, YIELDS, AND PRODUCT SPECIFICATIONS

	Texas Panhandle vacuum bottoms
Charging stock—	
Gravity, °A.P.I.	18.9
Material boiling at lower than 950° F., per cent by volume	2.0
Sulfur, per cent by weight	0.6
Conradson carbon, per cent by weight	11.7
Viscosity (Saybolt Furol) at 122° F., sec.	1,227
Characterization factor, U.O.P.	12.3
Per cent on crude	10.0
Operating conditions—	
Oil inlet temperature, °F.	690
Coke inlet temperature, °F.	990
Coke outlet temperature, °F.	915
Average reactor temperature, °F.	955
Reactor pressure, psig.	36
Mass lift—	
Coke circulation, tons per hour	75
Lift-tank pressure, psig.	130
Lift steam, lb. per hour	650
Yields, per cent by weight—	
C_3 and lighter	14.5
C_4 to 400° F. gasoline	22.0
Gas oil	51.0
Coke	12.5
	100.0
Inventory coke—Screen analysis—	
Per cent by wt. retained on screen:	
Tyler Screen No.	
0.25-in. mesh	49.0
4 0.187-in. mesh	21.4
6 0.131-in. mesh	13.8
8 0.096-in. mesh	12.6
12 0.065-in. mesh	1.8
18 0.039-in. mesh	0.9
Pan	0.5

Product inspection:	
Gas analysis, per cent by weight—	
Methane and lighter	18.1
Ethylene	11.1
Ethane	15.5
Propylene	25.4
Propane	3.3
Butane	13.0
Butylene	13.6
	100.0
Per cent olefins	50.1
Gasoline—	
Gravity, °A.P.I.	54.4
A.S.T.M. distillation, °F.:	
Initial boiling point	136
10 per cent point	202
50 per cent point	281
90 per cent point	362
End point	395
Research octane number:	
Without TEL addition	76.5
With addition of 3 ml. TEL per gal.	83.0
Characterization factor, U.O.P.	11.9
Aniline point, °F.	99.0
Sulfur, per cent	0.14
Gas oil—	
Gravity, °A.P.I.	27.5
Vacuum distillation, °F. at 760 mm.:	
Initial boiling point	400
10 per cent point	500
50 per cent point	760
90 per cent point	1,050
Characterization factor, U.O.P.	11.85
Coke—	
Bulk density, lb. per cu. ft.	64.0
Volatile matter, per cent by weight	3.7
Ash, per cent by weight	1.0
Sulfur, per cent by weight	0.6

Product Specifications

Fig. 4 presents the relationship between the octane number of the gasoline vs. average reactor temperature. For a reaction temperature of 950° F., the octane number, A.S.T.M. D 908 (research method), without TEL addition, is 75; whereas at a temperature of 1,025° F. the octane number is 84. The lead susceptibility of the gasoline is improved approximately 6 to 8 points with the addition of 3 ml. of TEL. Octane numbers of the gasoline produced on a delayed-coking unit from the same paraffinic stock will run 10 to 15 points lower.

A gas analysis is presented in Table 1. It will be noticed that the olefin production is approximately 50 per cent of the total gas. The corresponding yield of olefins from delayed coking is about 15 per cent. This concentration of olefins could be increased considerably by operation at higher coke temperatures. Some refiners will be interested in a maximum of gas production with high olefin content for chemical-plant feed stock. A pilot unit is presently in operation to investigate the high temperature levels for maximum production of olefins.

The specifications of the gas oil from the contact coking unit are similar to gas oil from the delayed coking unit when the same heavy stock is charged. Normally the charging stock to a delayed coking unit is a long reduced crude which contains a high percentage of virgin middle distillate.

The industry today requires, and in the future will require, higher yields

of middle distillates. Vacuum distillation carried to a heavy pitch produces a maximum of virgin distillate. The contact coker then provides a new tool to handle and convert the heavy pitch to gasoline and additional gas oil. Also the middle distillate, which normally is used as cutback to make marketable fuel oil of the vacuum bottoms, is then available for other uses.

Accompanying is a photograph of a sample of the equilibrium-coke inventory. The coke is of high mechanical strength, and withstands shock heating and cooling without noticeable fracture or failure. It is free-flowing, and has proved to be an excellent medium for supplying the required heat to the oil. The product coke is essentially spherically-shaped, and it is approximately ½ in. in diameter. It is harder and lower in volatile content than petroleum coke which has been produced in a delayed coker. The ash content and sulfur depend on the source of the feed stock. The product coke normally is suitable for electrode manufacture when calcined.

Process equipment . . . Because this unit represents a 10-to-1 increase in capacity over the 100-bbl. per day pilot plant previously operated, some "scale-up" factor problems could be expected. The novel features of the process equipment are the oil-coke mixing system, the mass-lift system, and the coke reheater. The mixing system required considerable time to obtain perfect performance. Fortunately, the final solution is one which readily may be extrapolated to much larger sizes.

The mass-lift operation was complicated by the radical difference in the characteristics of the petroleum coke used as "seed" and the equilibrium material obtained after startup. However, minor modifications resulted in satisfactory operation.

The coke-reheater capacity was somewhat inadequate, and could not be corrected fully without extensive changes to the original equipment. The reduced heat input to the coke has limited the oil-charge capacity.

Tests have shown that the other equipment is adequate for the design capacity. The unit also has operated satisfactorily at the design coke-oil ratio by reduction of the coke circulation. In a new unit the reheater deficiency can be corrected readily on the basis of data obtained during operation of this unit.

Investment and Operating Costs

Based on the experience with the 1,000-bbl. per day unit, there is under design a 2,500-bbl. per day unit which incorporates the modified mechanical features.

An economic comparison of a 2,500-bbl. per day continuous contact coking unit vs. a delayed unit has been prepared on the basis of charging Panhandle vacuum bottoms. These data are presented in Table 3. The comparison indicates that, at this capacity, the over-all economics favors the contact coking process.

When credit is allowed for the potential recovery of olefins in the product gas at a value of 3 cents per pound, the total differential profit is $2,171,280 per year. The corresponding figure for a delayed coking unit is $1,656,480 per year. The difference favors the contact coker by $514,000 per year.

The over-all operating labor required is considerably less for a contact unit. The coke drum turn-around labor, which normally consists of unheading, coke cleaning, and reheading of the drums, is eliminated. The unit is handled by two operators.

TABLE 3—COMPARISON OF CONTACT WITH DELAYED COKING—PROCESSING 2,500 BBL. PER DAY OF VACUUM BOTTOMS

	Contact process		Delayed coking process	
Unit—	Per cent by wt.	Per cent by vol.	Per cent by wt.	Per cent by vol.
Yields—				
Gas, C_3 and lighter	14.9		7.5	
Gasoline, C_4 to 400° F. e.p.	21.1	26.6	18.5	23.4
Gas oil	51.0	55.0	54.0	58.0
Coke	13.0		20.0	
Olefins in gas	50.1		15.1	
Utilities—				
Water, g.p.m.	1,600		2,200	
Steam, lb. per hour	13,000		10,000	
Fuel, million B.t.u. per hour	29		25	
Electricity, kw.	50		50	
Operating labor, men per shift	2		4	
Investment, dollars	1,600,000		2,100,000	
Direct charges, dollars per day—				
Raw material	2,500		2,500	
Utilities	417		363	
Labor	108		216	
Maintenance	110		130	
Total charges	3,135		3,209	
Value of products, dollars per day	8,151		7,765	
Differential profit,* dollars per day	5,016		4,556	
Differential profit,* dollars per year	1,655,280		1,503,480	
Payoff,* months	11.6		13.9	

Assumed Values of Charging Stock, Products, Utilities, and Labor

	Contact process and delayed coking process
Charging stock, dollars per bbl.	1.00
Products—	
Gas, cents per million B.t.u.	29
Gasoline, cents per gallon:	
80 O.N.	11.75
64 O.N.	11.00
Gas oil, dollars per bbl.	3.00
Coke, dollars per ton	6.00
Utilities—	
Water, cents per 1,000 gal.	1.5
Steam, cents per 1,000 lb.	55
Fuel, cents per million B.t.u.	29
Electricity, cents per kw.-hr.	0.75
Labor (cost per hour), dollars	2.25

*Does not include taxes, insurance, amortization, interest, and royalties.

Summary

Continuous contact coking is a new process for the upgrading of heavier residues than normally can be handled by the conventional delayed coking method.

A continuous contact coking unit, in combination with vacuum flashing to a heavy pitch, will produce a maximum of middle distillate, and thus provide a new tool to assist in meeting the industry's need for higher yields of middle and light distillates.

The inherent flexibility of the process permits processing stocks of widely different characteristics and, by varying the operating conditions, a much wider range of yields and product specifications are obtained than heretofore possible.

The process is continuous, and thus eliminates the intermittent cleaning of coke drums and attendant expense.

The product coke is clean, hard, uniform in size, and easily handled and marketed.

The capital investment and operating labor for a contact unit are less than for a delayed coking unit.

Engineering designs for a 2,500-bbl. per day unit are now being completed.

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2. A. H. Schutte, "Application of Contact Coking to California Refining," Calif. Oil World 42 (19) 5 (1949).

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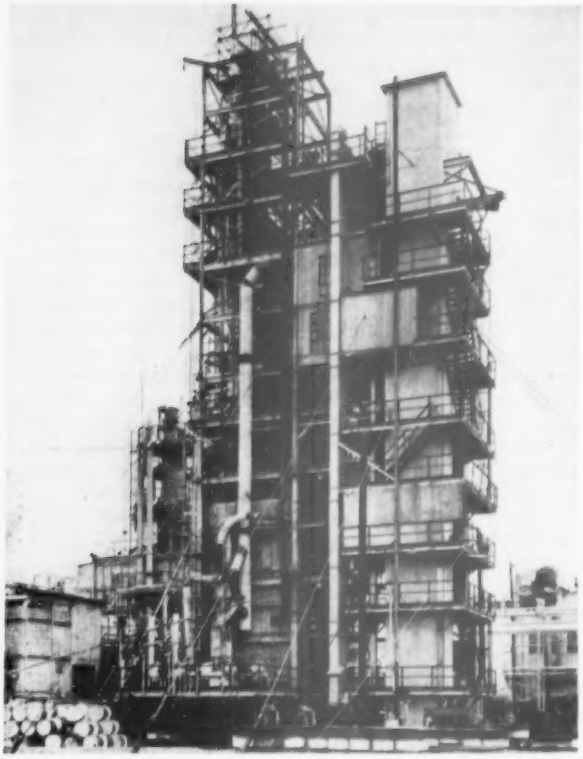
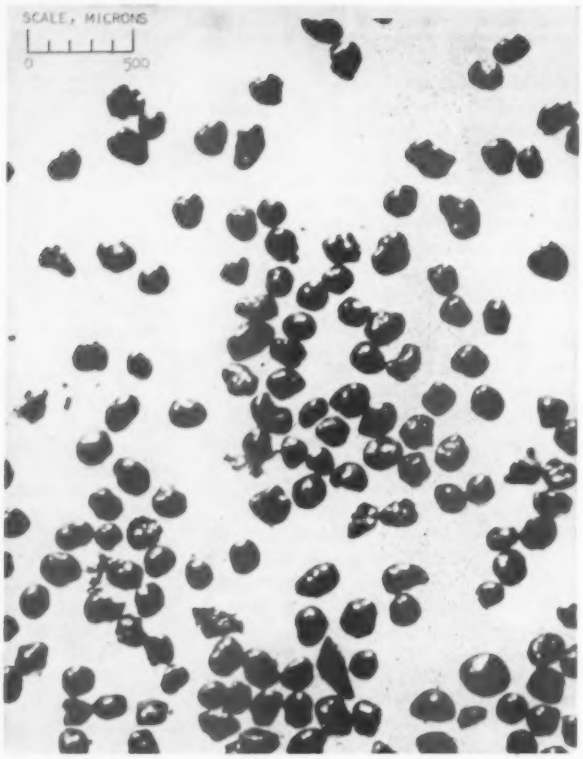


FLUID COKING pilot plant was adapted from the original fluid catalytic cracking plant in Baton Rouge. Capacity is 100 bbl. per day.



COKE PRODUCED from fluid coker has uniform particle size, is easily handled as fluid, and is clean, dustless solid.

A.P.I. SESSION ON REFINING PROCESSES

FLUID COKING OF RESIDUA

Here's an economical method for reducing fuel-oil production

by A. Voorhies, Jr.,* and H. Z. Martin†

THE Esso Laboratories at Linden, N. J., and at Baton Rouge, La., have developed during the past few years a new coking process which has been named "fluid coking." Basically, this process is an adaptation of the fluidized-solids technique to the coking of crude residua and similar low-grade oils.

The fluid coking process employs no catalyst; it depends on a circulating stream of finely divided coke particles to furnish the heat necessary to accomplish the coking reaction. By virtue of the small size of the coke particles, the available surface for heating is very large.

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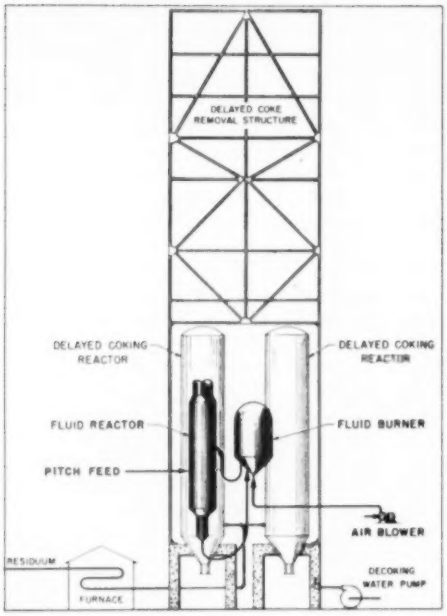
Incentive . . . During recent years there has been considerable incentive for upgrading residua because of the spread in price between crude and fuel oil. Only during the period 1946-48 did fuel-oil prices equal those of crude. The demand for heavy fuel oil relative to lighter petroleum products has been steadily decreasing with the years. Therefore, refiners have been seeking economical methods for reducing fuel-oil production based on vacuum distillation, deasphalting, and coking.

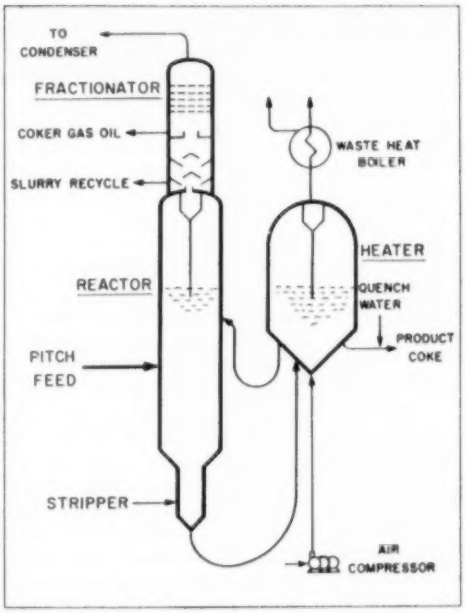
Vacuum distillation has found extensive use in maximizing the production of catalytic cracking feed stocks, although the extent to which crude can be reduced by this means is dependent on crude quality. Therefore, the quantity of the resulting residuum may vary from as little as approximately 4 per cent for such crudes as South Louisiana to 40 to 50 per cent for some of the heavier crudes which are now coming into the picture.

The chief limitations to an increase in the amount of gas oil taken overhead in vacuum distillation are: (1) the tendency of the high-boiling components to crack to excessive quantities of gas; and (2) the carryover of traces of metals which contaminate cracking catalysts. As the percentage overhead obtained by vacuum distillation of a metal containing reduced crude is increased, the concentration of metal in the distillate increases in a regular manner. Therefore, flash cut points are usually held at about 1,000° to 1,050° F.

Propane deasphalting is similar to distillation in that separation of asphalt, color bodies, and other undesirable con-



PLANT SIZE comparison for delayed and fluid coking units of the same feed-charge capacity. Fig. 1.



SCHEMATIC FLOW PLAN of the elements in a fluid coker. Fig. 2.

stituents from reduced crudes is effected primarily according to molecular weight. Although the bulk of the metal-containing components is rejected in the higher-molecular-weight asphaltic fractions, varying proportions of the lower-molecular-weight metal-containing compounds are retained in the deasphalted oil.

The application of deasphalting has been mainly for lubricating-oil production, and there are only three units in the United States and one unit outside this country which are operating for production of cracking feed stock.

New process . . . The recent announcement by Standard Oil Development Co. of the availability of the fluid coking process for licensing now makes available to the industry another truly continuous process. No periodic shutdowns for removal of coke are required, and the reactor can be maintained continuously at the desired operating conditions. The single reaction vessel required is considerably smaller than for delayed coking.

As an illustration, Fig. 1 shows a comparison of plant sizes for delayed and fluid coking units of the same feed-charge capacity. Estimates indicate that the process will be lower in investment and operating costs than are the older coking methods.

Experimental studies on fluid coking were started several years ago in a small, continuous fluid-solids pilot unit. These preliminary tests served to show the possibilities of the process and pointed out the fields for research and development. Next, a systematic study of the process was conducted in a unique "bench scale" pilot plant with interchangeable reactors heated in a fluidized sand bath.

Here it was established that favorable yields could be obtained from even the heaviest pitches, and that temperatures in the range of 850° to 1,050° F. were well-suited for catalytic cracking feed-stock production. However, these small units were batch fluid units. Larger equipment was needed to demonstrate continuous fluid coking, and attention was turned to a 100-bbl. per day pilot plant.

Ideally suited for this study was the original 100-bbl. per day fluid catalytic cracking pilot plant, built at Baton Rouge in 1940, and used since then for several projects, including fluid retorting of oil shale and demonstration of the Model IV fluid cracking unit design. With a few essential modifications, the plant was converted from a Model IV catalytic cracker into a coking plant.

Of course, the entire feed-introduction system was new in order to permit direct injection of pitch into the reactor. Only sufficient heating of the pitch feed is required to lower its viscosity for easy handling. A photograph of the 100-bbl. per day fluid coking pilot plant is shown on the previous page.

Process features . . . A schematic flow plan of the elements of a fluid coker is shown in Fig. 2. It will be observed that the unit consists basically of a reaction vessel and a burner vessel. Operating pressures are substantially atmospheric, but may be higher if desired. The residuum feed is preheated and then is injected into a bed of hot fluidized coke particles which are formed in the process.

These spheroidal coke particles are small in size, although generally somewhat coarser than fluid cracking catalyst, and thus provide a large amount of surface per cubic foot of fluidized material. This large surface serves the multiple functions of: (1) retaining the pitch during conversion; (2) aiding in the evaporation of products; and, (3) providing an area for coke deposition.

The basic function of the fluid coke is that of a heat carrier. Rapid heat transfer is obtained by virtue of the fine particle size of the fluid coke. As the feed is injected into the reactor, it is, therefore, heated up very quickly. At reactor temperatures the viscosity of the residuum is low so that its distribution over the surface of the fluidized solids is rapid and uniform.

In the reaction zone the heavier fractions of the feed stock are only partly vaporized, most of the cracking reaction being effected in the liquid phase. However, the more volatile products are rapidly evaporated from the surface of the coke so that the products consist of a dry overhead vapor and dry coke. Excellent mixing takes place in the fluid bed, and this gives virtually isothermal conditions in the reactor, just as is the case in fluid catalytic cracking.

The vapor products from the fluid bed are taken overhead through a cyclone separator located in the upper end of the reaction vessel. Most of the entrained solids are separated at this point and returned to the fluid bed. The overhead product, with a small amount of coke dust, is then passed to fairly conventional refining equipment.

Some recycle bottoms are returned to the reactor in order to carry back the small amount of coke which has escaped through the cyclone and to permit recracking of the bottoms into the gas-oil boiling range.

Heat generation . . . The heat for carrying out the coking process is generated in the burner vessel. The fluidized coke from the reactor, which has been steam-stripped in the bottom of the reactor, is transferred to the burner by a standpipe riser system. Air is supplied to the bottom of the burner, and only enough coke is burned to maintain the system in heat balance.

For example, the temperature in the fluid-bed burner may be maintained in the range of 1,100° to 1,200° F. In a typical installation the amount of coke burned is equivalent to 4 to 5 per cent by weight on feed. If desired, extraneous fuels may be substituted for the coke burned. The heat from the burner vessel is transferred to the reactor by the maintenance of a flow of solids between the two vessels.

Because only a part of the coke deposited is burned to supply heat, the coke particles grow in size during the process. In order to counteract the growth process and to maintain a constant particle-size coke inventory, fine coke must be added continuously to serve as growth "seeds." The seeds required can be supplied either by grinding withdrawn coke in external equipment or by devices in the unit itself. However, because the seed coke is much smaller in diameter than the average of the withdrawn coke, the weight of seed required is only a small percentage of the weight of coke withdrawn.

As can readily be visualized, the process is flexible in the range of permissible operating conditions. For example, higher or lower temperatures may be employed. Also, there is considerable flexibility in the choice of particle size of the circulating fluid coke. However, this circulating coke generally is somewhat coarser than the normal fluid cracking catalyst, which is largely material through 100 mesh.

The fluid coking process is completely continuous, and operates just as simply as fluid catalytic cracking. But, aside from the continuous nature of fluid coking, the process possesses some other advantages over conventional delayed coking. No preheat furnace is required. Residua are normally available at 500° to 700° F., and this temperature is adequate for good feed dispersion. Thus, the furnace-coking problem is not a factor in the process.

There appears to be no feed limitation if the stock can be handled in pumps and pipes. Fluid coking pilot plants have been operated on feeds which vary in boiling range from whole crudes to residua having close to a 1,200° F. initial boiling point.

The 100-bbl. per day fluid coking unit at Baton Rouge has been in oper-

TABLE 1—100-BBL. PER DAY FLUID COKING PLANT—ONCE-THROUGH OPERATIONS ON THREE VACUUM RESIDUA

Feed-stock source—	South Louisiana mixture	Elk Basin	Hawkins Batch 1
Feed inspections:			
Gravity, °A.P.I.	13.2	2.5	4.5
Conradson carbon, per cent by weight	14.0	30	23.2
Ash, per cent by weight	0.23	0.11	0.07
Sulfur, per cent by weight	0.9	3.5	4.5
Viscosity (Saybolt Universal) at 275° F., sec.	18	393	342
5 per cent point, °F.	Cracks	1,000	902
Correlated yield on first pass:			
C_5 to 430° F. F.V.T.* naphtha, per cent by volume	12.5	12	15
430° to 1,015° F. F.V.T. gas oil, per cent by volume	42.5	29	36.5
1,015°+ F. bottoms, per cent by volume	35	35	27
C_4, per cent by volume	2	2	2.5
C_3 and lighter gas, per cent, by weight	6.5	6.5	7
Coke, per cent by weight	8	23	19
Product quality:			
C_5 to 430° F. gravity, °A.P.I.	52.5	52	53
C_5 to 430° F. sulfur, per cent by weight	0.1	0.3	0.7
C_5 to 430° F. research octane number without TEL addition	78.5	78.5	78.0
Gas oil: gravity, °A.P.I.	23.5	19	16.5
Gas oil: sulfur, per cent by weight	0.4	2.8	3.7
Gas oil: Conradson carbon, per cent by weight	1.4	2.4	2.1
Bottoms: gravity, °A.P.I.	13	0.7	1.0
Bottoms: Conradson carbon, per cent by weight	14	30	26

*F.V.T.—final vapor temperature.

TABLE 2—ESTIMATED ULTIMATE YIELDS FROM FLUID COKING OF TWO VACUUM RESIDUA

Feed-stock source—	South Louisiana mixture	Hawkins Batch 2
Feed inspections:		
Gravity, °A.P.I.	13.2	4.0
Conradson carbon, per cent by weight	14	24
Ash, per cent by weight	0.23	0.07
Sulfur, per cent by weight	0.9	4.5
Ultimate yields, per cent on feed:		
C_5 to 430° F. F.V.T. naphtha, per cent by volume	21	21
430° to 1,015° F. F.V.T. gas oil, per cent by volume	61	52
1,015°+ F. bottoms, per cent by volume	0	0
C_4, per cent by volume	3	3
C_3 and lighter gas, per cent by weight	8	9
Coke (total), per cent by weight	16	27
430° to 1,015° F. F.V.T. quality:		
Gravity, °A.P.I.	23	17
50 per cent point, °F.	750	800

TABLE 3—QUALITY OF PRODUCT COKE FROM 100-BBL. PER DAY FLUID COKING PILOT PLANT

Vacuum residuum crude source—	S. Louisiana (partly desalted)	Elk Basin	Hawkins
Coke:			
Carbon, per cent by weight	92.5	88.6	88.3
Hydrogen, per cent by weight	1.6	1.8	1.9
Sulfur,* per cent by weight	1.4	6.4	7.0
Volatile matter, per cent by weight:			
At 1,100° F.	0.6	1.3	0.9
At 1,742° F. (950° C.)		5.3	5.0
Ash,* (Per cent by weight) at 1,100° F.	2.8	0.7	0.7
Ash components, as metal in coke:			
Vanadium, per cent by weight	0.01	0.17	0.02
Nickel, per cent by weight	0.01	0.06	0.01
Iron, per cent by weight	0.11	0.08	0.04

*Values for ash and sulfur are higher than will be obtained commercially for these two reasons: (1) a greater percentage of the coke make is burned in the pilot plant than is anticipated for commercial operation; and (2) the bottoms recycled commercially will have a lower ash-to-coke ratio than the portion of the feed converted in the one-pass pilot-plant operation.

ation for more than a year. Because the yield structure from the fluid coking process already had been determined in small-scale laboratory equipment, the primary purposes of operating the 100-bbl. per day plant were to get a convincing demonstration of the operability of the process and to get engineering data for large-plant design.

The operation of a pilot plant on the scale of the 100-bbl. per day unit gives excellent test of the operability of a new process. During the operation of the 100-bbl. per day unit the problems associated with continuous operation on a large scale have been systematically worked out, and operating techniques have been continually improved and perfected.

The year of experience in the operation of the 100-bbl. per day plant has clearly demonstrated the fundamental practicability of the fluid coking process. The circulating coke system has operated exceedingly well, and problems which arose in connection with the auxiliary equipment have been successfully met.

One problem was to find the best way to distribute the pitch into the fluid coke bed in the reactor so as to get optimum distribution of feed. As a result, a very satisfactory feed-injection system was developed and successfully demonstrated. Another problem which had been anticipated was associated with a tendency to form coke in overhead equipment. This is a common phenomenon when heavy ends are processed at high temperatures.

However, the fluid coking process inherently minimizes this problem, and a very successful solution was worked out. For example, a recent run in the 100-bbl. per day unit was terminated voluntarily after more than 500 hours at design conditions without any pressure drop in the overhead lines up to the point where quench oil is normally introduced in commercial equipment.

Typical yields . . . Typical fluid coking yields from operations in the 100-bbl. per day plant on three feed stocks are shown in Table 1. The feeds are all vacuum bottoms. The South Louisiana mixture is a light sweet blend, predominantly South Louisiana crude, whereas Elk Basin and Hawkins are much heavier sour crudes. These large-pilot-plant data are for once-through operation, but most commercial plants would be run with recycle to 100 per cent conversion of the material boiling above the gas oil.

In the examples shown in Table 1, this gas oil was cut at a 1,015° F. still vapor temperature, and this produced a feed suitable for catalytic cracking. However, it is not implied that 1,015° F. is necessarily the optimum cut point. This point will depend upon the feed stock and the operating conditions. Also, it should be emphasized that the 100-bbl. per day plant was run primarily to obtain operating and engineering data; and, hence, the yields shown in Table 1 are not optimum.

The coker naphthas from the three feeds shown in Table 1 are quite similar except for sulfur content, and that value varies with the feed stock. Unlike the relatively uniform quality of the gasoline, the quality of the coker gas oil is considerably affected by the character of the coker charge stock. In Table 1 it can be seen that the higher grade South Louisiana residuum gave a higher A.P.I. gravity and lower Conradson-carbon gas oil than the heavier Elk Basin and Hawkins feeds. Of course, the coker bottoms follow the same trends. In general, the quality of the coker bottoms is not far from that of the residuum feed.

In order to estimate ultimate yields with bottoms recycle to extinction, successive pass coking has been conducted in the laboratory pilot plants on the 1,015°+ F. bottoms from once-through coking. From these data ultimate yields for favorable coking conditions have been calculated for two feeds, and are shown in Table 2. The residuum was converted from fuel value to 76 to 85 per cent by volume of gasoline and gas oil and 24 to 36 per cent by weight of fuel products.

It will be noted that the coke yields are close to the Conradson carbon of the original feed. This is typical of the data on a wide variety of feeds, and is another way in which fluid coking differs from delayed coking. In the latter process coke yields are closer to twice the feed Conradson carbon.

Properties of Fluid Coke

The coke produced in fluid coking has some interesting and unique properties. Its fine, but uniform, particle size makes it easily handled as a fluid but, nevertheless, it is a clean, dustless solid. The roundness of the particles, (see accompanying photomicrograph) is a property which may make possible some unique applications. Chemical and physical properties are given in Table 3.

The low hydrogen and volatile matter in the coke are an indication of the calcination which takes place in the burner vessel. The coke is expected to find its way into the already established markets for petroleum coke; e.g., as fuel, for electrodes, and for other products. Studies are being made on the use of fluid coke as raw material for the manufacture of electrodes for the aluminum industry. The transportation of fluid coke can be adequately handled by pipe lines, gondola railway cars, barges, and other carriers.

Cracking of Coker Gas Oil

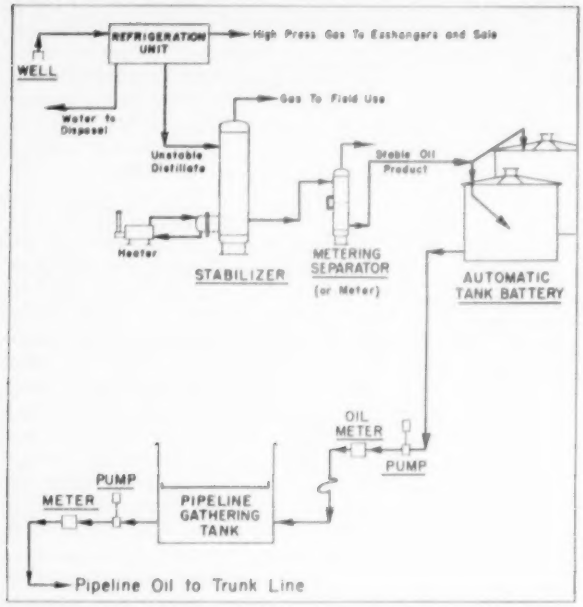
For the recycle coking operation, the yields shown in Table 2 are based on the production of a 430° to 1,015° F. gas oil for subsequent catalytic cracking. As already pointed out, the choice of the 1,015° F. cut point is somewhat arbitrary. The optimum end point may be higher or lower depending on the composition of the original residuum with respect to metals—nickel, vanadium, iron—which are undesirable contaminants of cracking catalysts.

Of course, a similar situation exists in the primary distillation of the crude in vacuum towers to produce a high-end-point virgin gas oil for catalytic cracking. In this primary vacuum distillation, as in fluid coking, trace quantities of very high-boiling volatile metal compounds—nickel, vanadium, iron—are taken overhead when high-end-point gas oils are produced, and the quantity of such trace catalyst poisons depend both on the cut point and on the composition of the crude.

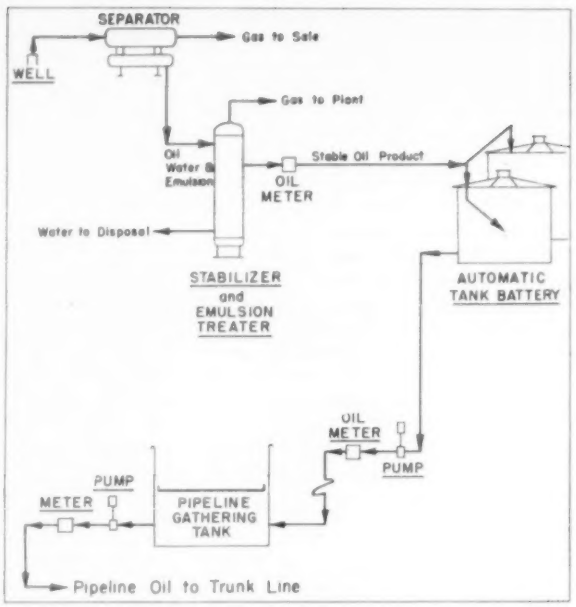
In the preparation of feed stocks for catalytic cracking it is generally economical to go to the highest end point of gas oil consistent with tolerable quantities of these catalyst contaminants.

However, in many refinery situations, especially when catalytic cracking equipment is not available, the opportunity exists for a very simple combination of fluid coking and thermal cracking. In this case the fluid coking is conducted once-through—which somewhat shrinks the size of the coking unit—and the total coker overhead minus the gasoline fraction may be fed directly to a thermal cracking unit.

Commercial application . . . Standard Oil Development Co. is making the process available to the industry under license at reasonable royalty rates. As already announced, affiliates of Standard Oil Co. (N. J.) have plans for building three fluid cokers in the United States. The first commercial installation, which is already in the design stage, is for the Billings, Mont., refinery of Carter Oil Co. This is a 3,800-bbl. per day unit, and is scheduled for initial operation in late 1954. Esso Standard Oil Co. plans to follow about a year later with a 10,000-bbl. fluid coker at Baltimore and a 21,000-bbl. unit at Baton Rouge.



LEASE-TANKAGE setup for gas-distillate production. Unit is typical high-economy installation, with maximum product recovery.



CRUDE-OIL PRODUCTION is made more economical and efficient by this lease-tankage setup. Automatic operations are featured.

Whither Lease Tankage?

. . . Is this the weak link in the production chain?

Proper separation and stabilization steps, installed before the produced fluids are sent to lease tanks, insure efficient, economical operation. Automatic operation of these facilities seems necessary for best results.

by Knox B. Henderson

AUTOMATIC operation of tank batteries and production equipment upstream of the tank battery is in evidence today, but is not yet a dominating factor in field lease operation. However, it may soon become a most important factor in lease production.

These combined operations, when developed to the point of greatest economy, provide for:

- Proper preparation and separation of both gas and water from crude oil.
- Stabilization of the oil, thus providing for pipe-line delivery an oil that will lose the least volume in transportation and storage.

Use of stabilizers permits the proper handling of the most volatile hydrocarbons in any lease work. Resulting tank products may then be handled with little hydrocarbon loss, and maximum revenue will accrue to the operator.

Author is associated with National Tank Co., Tulsa. Paper presented before session on transportation, annual meeting of A.P.I., Chicago, November 10.

Automatic operations . . . There are several types of automatic operations. One of the most versatile and practical at this time is an electric system. Imagine operating a lease under water during floods without missing a barrel of production. This is being done today, but only in isolated cases.

Each well is individually controlled on a stopcock plan so that the lease is operating at an average rate at the separator, but at an intermittent rate at each well.

Each tank at the battery fills but not necessarily in the same order as standing on the grade. If three tanks were in the battery, the No. 2 could be on the line, No. 1 could be filling, and No. 3 ready to fill. The control of this system will hunt the open tank. If no open tanks are available, the control will shut in the wells.

Another possible factor of the future is the metering separator. It has been on the scene many, many years with little success, but with the advent of stable crude oil to measure, it should become an important piece of equipment.

There are many outcropping methods of production and any one of them could be the pattern of the future. Horizontal pressure tanks for crude oil or gas-distillate will be of little advantage when the hydrocarbons are stabilized.

Manufacturing companies have the ability to design and furnish more complicated equipment than is yet being used on the lease, but such equipment is of little real value to the user company unless this type of equipment is properly employed.

Today and in the future, the stabi-

lized product will solve more production and transportation problems than any other one approach to the aim: "Deliver the greatest possible percentage of the produced liquid from well head to refiner," for both crude oil and gas distillate, the byproduct of natural gas.

Future Tank Batteries

Conventional methods of production and lease-tank equipment point to the need for some of the following developments:

Automatically produce wells on a predetermined cycle:

1. Produce stabilized liquid products.
2. Gage through metering separators.
3. Gage through oil meters.
4. Automatically fill and switch tanks.
5. Automatically transfer custody to pipe lines through such atmospheric pressure tanks, thereby accomplishing second gaging check.
6. Gage through another meter after tanks but ahead of area pipe-line gathering tank.

As confidence in this system is realized, lease tankage requirements will be reduced. Fewer man-hours will be expended to produce, gage, and transfer custody of the oil. In some areas, the installation of automatic lease production equipment has permitted an eventual man-hour reduction of two-thirds to produce the several hundred wells in the area.

With all production and transfer of custody problems handled satisfactorily, the producing well may eventually lead directly to the processor, with no loss of well product on the lease.

Stable Liquids From Gas-Distillate Wells

Perhaps the most difficult problem to the producer and pipe line is: How can stable products and maximum recovery be accomplished at field locations?

To more clearly examine an answer and at the same time satisfactorily point out that there is no rule of thumb for answers to production-equipment problems, take two actual hydrocarbon analysis of gas-distillate streams:

Component	Well "A"	Well "C"
C_1	91.71	80.11
C_2	4.44	8.76
C_3	1.50	4.98
C_4	.86	2.58
C_5	.32	1.46
C_6+	1.17	2.11
Mole per cent	100.00	100.00

There are two popular bases of analyses of total liquid product sold from a lease:

1. Using the mole of well effluent and determine the volume of gas that can be sold at sale gas-line conditions, and determine the volume of 18-psi. true-vapor-pressure product that can be sold.

(Note: 18-psi. true-vapor-pressure product is taken as a product that will stay in storage at 2-oz. pressure at usual storage temperatures.)

2. Use the volume of liquid sold per million cubic feet of sale gas.

Neither of these bases give an opportunity to quickly compare the recovered energy in direct comparison with another well considered to be a similar problem. For my own understanding, I have used the basis of 100,000 lb. of well product in each case.

Theoretical 18-psi. product calculated to be in the well streams: Well "A," 10,080 lb.; Well "C," 17,255 lb.

It is well to note that the following comparisons are based on coming finally to an 18-psi. product. If we do not make that basis, it is possible to an indeterminent degree to put more, though unstable liquid in the tank than herewith indicated, but the product will become stable at a later date. This can be done either on the lease, if left there long enough, or down the line somewhere else, and when it does stabilize by uncontrolled means, in all probability the final volume will be less than if done properly at the lease.

There are other assumptions to be made:

Gas is to be sold at a pressure to cause the high-pressure separator to operate at 815 psia. Tank storage will be at 15 psia. and 80° F. Temperatures will be appropriate to the operation of each system.

Effect of Production Equipment on Amount of Well Fluids Recovered in Lease Tanks

Two-stage separation:

Using one high-pressure separator and tanks:

	18-psi. product recovered at tanks				
Well	Pounds	Barrels	Per cent of theoretical	S.c.f. sold, 1,000's	Total bbl. sold per 1,000 M.c.f.
A	6,337	23.7	63	1,978,753	12
C	11,818	45.6	68.5	1,546,232	29.5

Three-stage separation:

By adding a low-pressure separator between the high-pressure separator and bolted tanks, additional recovery can be made.

Additional recovery for intermediate separator at 110 psia.:

	Additional 18-psi. product at tanks				
Well	Pounds	Barrels	Total % of theoretical	S.c.f. sold off high-pressure sep.	Total bbl. sold per 1,000 M.c.f.
A	227	1.1	65	1,978,753	12.6
C	1,937	8.8	80	1,546,232	35.2

High-pressure separator—desorber—tanks:

Replace the low-pressure separator with the commonly known tool in the refinery, a modified stabilizing desorber and more recovery is made.

Additional recovery for low-pressure desorber:

	Additional 18-psi. product at tanks				
Well	Pounds	Barrels	Total % of theoretical	S.c.f. sold off high-pressure sep.	Total bbl. sold per 1,000 M.c.f.
A	336	1.6	68.4	1,978,753	13.4
C	1,770	7.9	90	1,546,232	40.6

Low-temperature extraction unit—desorber—tanks:

Now add a low-temperature extraction unit in place of the high-pressure separator and see what happens.

	Additional 18-psi. product at tanks				
Well	Pounds	Barrels	Total % of theoretical	S.c.f. sold off high-pressure sep.	Total bbl. sold per 1,000 M.c.f.
A	1,752	7.3	85.8	1,961,700	17.2
C	1,648	6.7	99.5	1,464,800	47.4

Thus, the production equipment has a vast effect on the total volume of liquid sold from a lease. Tanks are a part of the production equipment, and will be influenced greatly by extraordinary changes in lease or pipe-line practices.

Short-cut method of

Selecting Pipe-Line Diameter For Minimum Investment

Here are the formulas that give the answers

by George F. Downs, Jr., and George R. Tait

A SIMPLIFIED method has been developed for rapidly reaching a decision on the economic pipe size to be used in transporting given quantities of petroleum products.

Application of the method involves the use of certain equations developed on the basis that important items which affect the investment in a pipe-line facility can be expressed in terms of line size (pipe diameter) or as constants. Results of the calculations show the lowest-cost pipe size in terms of the rate of flow, the physical properties of the product, and the ratio of investment in power to investment in pipe.

General Formula for Investment in Pipe-Line Facilities

The investment in pipe-line facilities can be expressed by the following general formula:

Authors associated with Phillips Petroleum Co., Bartlesville, Okla. Paper presented before the pipe-line session, annual A.P.I. meeting, Chicago, November 10.

$$I = [C_1 (D) + C_2 (HP)] L \quad (1)$$

Where:

- I = total investment in pipe-line facilities under consideration, in dollars.
- C_1 = unit installation costs, expressed in dollars per inch of inside diameter per mile of pipe laid complete.
- D = inside diameter of pipe, in in.
- C_2 = unit cost of pumping facilities, expressed in dollars per horsepower.
- HP = horsepower capacity required per mile.
- L = length of pipe line, in miles.

It should be noted that there may exist certain fixed costs, not related to diameter or length, which are not taken into account in this formula. Because these costs do not vary with changes in diameter or length of line, it can be shown that they have no effect on the results.

Fig. 1 shows a plot of pipe-line installation costs in terms of the inside diameter of the pipe. These figures were developed by the estimating section of Phillips Petroleum Co. and are shown primarily for the purpose of explaining the workings of the company's minimum-cost formula. They are not necessarily representative of actual costs for such work.

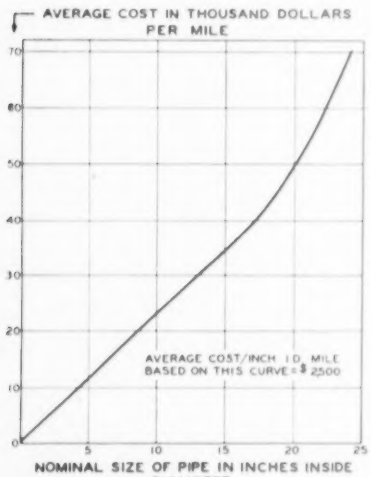


Fig. 1—Values of C_1. Average cost of pipe installed in the ground in dollars per mile, based on pipe having ¼-in. minimum wall thickness and including the following items: pipe; lay; coat; right-of-way and damages; casing points; river crossings; freight; and survey and inspection.

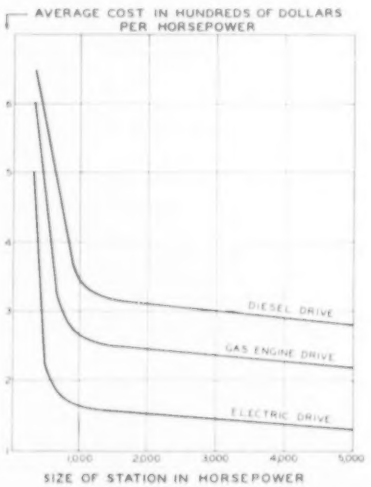


Fig. 2—Values of C_2. Average cost of horsepower: includes land, buildings, housing, utilities, controls, and piping; does not include fuel storage.

Most pipe-line companies have similar information based on their own experience, which information can be arranged in a manner similar to that shown in Fig. 1 in order to arrive at a value for C_1 (the cost per inch of inside diameter per mile of pipe line installed). As is indicated in Fig. 1, these costs include the delivered cost of the pipe; the costs of hauling, stringing, laying, coating, ditching, and backfilling; the costs of right-of-way and damages, river crossings, highway and railroad casings, survey, resurveys, and inspection at the mill and on the job; together with the costs of engineering, supervision, and overhead.

Cost data . . . Pipe-line-construction cost data may be obtained from other references. Two sources for pipe-line cost data include the Interstate Commerce Commission's "Guide Prices," and their "Annual Indices"[2] to bring these prices current, or the work done by W. L. Nelson, technical editor, The Oil and Gas Journal, in his series, "Cost-imating," which appeared weekly from October 21, 1948, to December 29, 1949.[3] This latter information is also kept current through quarterly installments published by The Oil and Gas Journal.

Fig. 2 gives a somewhat generalized plot of power costs and relates installed horsepower with values of the term C_2 (the cost of pumping equipment expressed in dollars per horsepower).

Here again, individual companies will no doubt have their own cost information which can be arranged in a manner to express total horsepower in terms of investment over a sufficient range to provide the necessary latitude in application of the formula.

To express the required horsepower in terms of pipe diameter, the following substitutions are necessary:

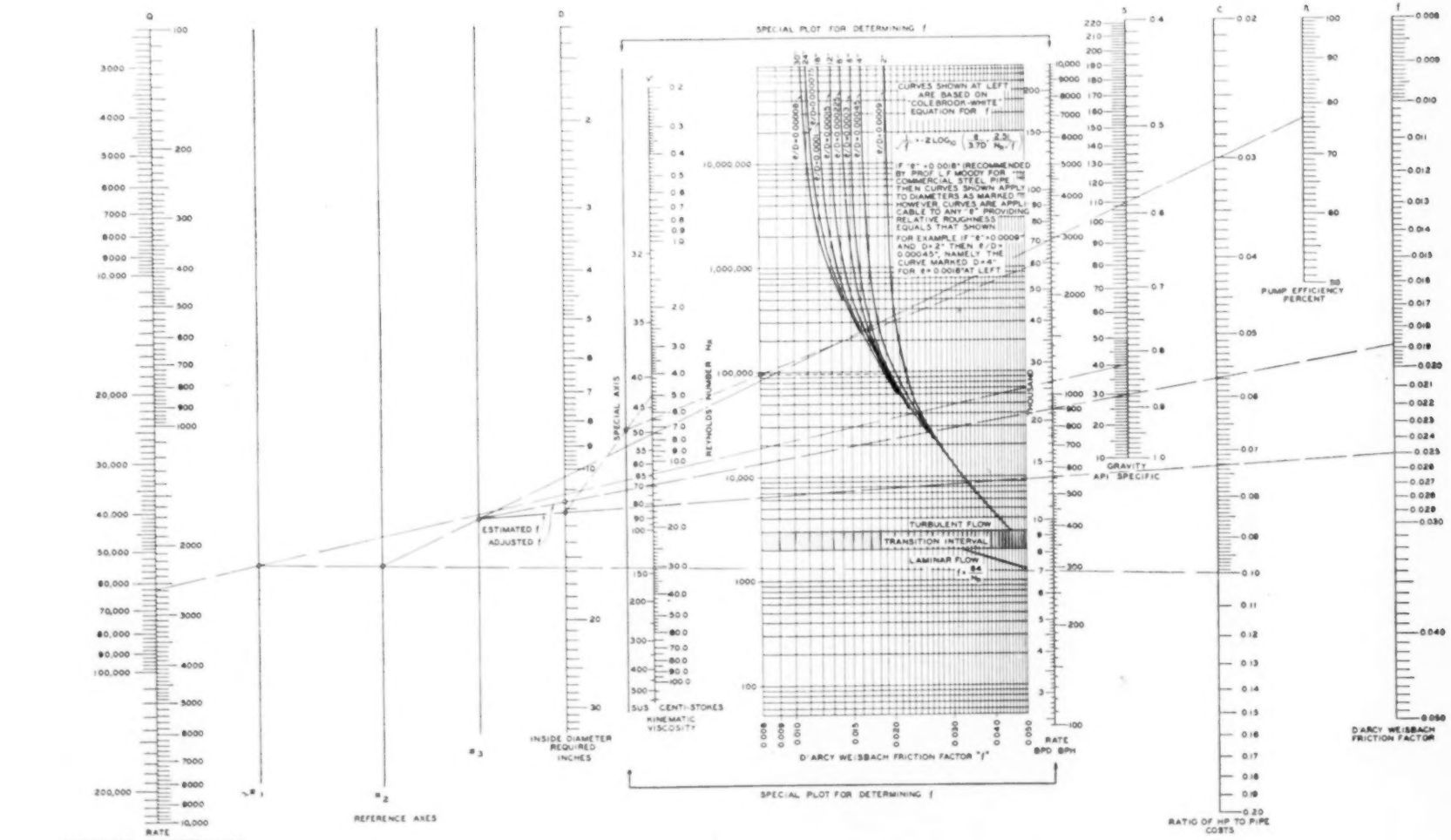
$$HP = 0.00001701\ PQ/\eta \quad (2)$$

Where:

- P = pressure drop in pipe line, in psi. per mile.
- Q = throughput, in barrels of 42 U. S. gal. per day.
- η = efficiency of pumping unit.

Equation 2 introduces a new term P (the pressure drop in the pipe line in pounds per square inch per mile).

The relationship of pressure drop to


Q
RATE
BARRELS / DAY
BARRELS / HOUR
REFERENCE AXES
D
INSIDE DIAMETER REQUIRED INCHES
SPECIAL PLOT FOR DETERMINING f
SPECIAL AXIS
V
SUS CENTI-STOKES
KINEMATIC VISCOSITY
REYNOLDS NUMBER Nr
THOUSAND
CURVES SHOWN AT LEFT ARE BASED ON "COLEBROOK-WHITE" EQUATION FOR f
IF "ε" = 0.0018" (RECOMMENDED BY PROF. L.F. MOODY FOR COMMERCIAL STEEL PIPE) THEN CURVES SHOWN APPLY TO DIAMETERS AS MARKED. HOWEVER, CURVES ARE APPLICABLE TO ANY "ε" PROVIDING RELATIVE ROUGHNESS EQUALS THAT SHOWN.
FOR EXAMPLE IF "ε" = 0.0009" AND D = 2" THEN ε/D = 0.00045", NAMELY THE CURVE MARKED D = 4" FOR ε = 0.0018" AT LEFT
TURBULENT FLOW
TRANSITION INTERVAL
LAMINAR FLOW
f = 64/Nr
D'ARCY WEISBACH FRICTION FACTOR "f"
RATE BPD BPH
SPECIAL PLOT FOR DETERMINING f
S
GRAVITY API SPECIFIC
C
RATIO OF HP TO PIPE COSTS
η
PUMP EFFICIENCY PERCENT
f
D'ARCY WEISBACH FRICTION FACTOR
ESTIMATED f
ADJUSTED f
#1
#2
#3

NOMOGRAM FOR THE SOLUTION OF THE FOLLOWING EQUATION

$$D = 0.(3)\, Q^{0.36} \left(\frac{3cf}{\eta}\right)^{0.18}$$

WHERE

D = DIAMETER IN INCHES I.D. WHICH FOR VARIABLES USED IS LINE SIZE FOR MINIMUM INVESTMENT
Q = RATE IN BARRELS PER DAY
S = SPECIFIC GRAVITY
C = RATIO, COST OF HP ÷ COST OF PIPE PER INCH I.D. PER MILE
η = PUMP EFFICIENCY PERCENT
f = D'ARCY WEISBACH FRICTION FACTOR

EXAMPLE

GIVEN Q = 82,400 BARRELS PER DAY
S = 40.3° API
HP ÷ $3,250 EACH
PIPE ÷ $2500 PER INCH I.D. PER MILE
C = 0.10
V = 42.5 SUS
ESTIMATE η = 77%
f = 0.025

CONNECT Q = 82,400 B/D TO S = 40.3° AND MARK THE INTERSECTION OF THIS LINE ON REFERENCE AXIS #1. USE THIS POINT ON REFERENCE AXIS #1 AS A TURNING POINT AND CONNECT WITH C = 0.10 AND MARK THE INTERSECTION OF THIS LINE ON REFERENCE AXIS #2. USE THIS POINT ON REFERENCE AXIS #2 AS A TURNING POINT AND CONNECT WITH η = 77% AND MARK THE INTERSECTION OF THIS LINE ON REFERENCE AXIS #3. USE THIS POINT ON REFERENCE AXIS #3 AS A TURNING POINT AND CONNECT WITH f = 0.025 AND READ ANSWER AT INTERSECTION OF THIS LINE ON D SCALE, HERE = 12.23".

TO CORRECT THE ESTIMATED "f" PROCEED AS FOLLOWS. CONNECT THE D JUST FOUND (12.23") WITH V = 42.5 SUS AND MARK THE INTERSECTION OF THIS LINE ON THE SPECIAL AXIS. USE THE POINT ON THE SPECIAL AXIS AS A TURNING POINT AND CONNECT WITH THE INVERTED G SCALE FOR Q = 82,400 B/D AND MARK THE INTERSECTION OF THIS LINE ON THE N_R SCALE. PROCEED HORIZONTALLY ON THE N_R JUST FOUND TO D = 12" AND READ f = 0.0188. GO BACK TO THE POINT ON REFERENCE AXIS #3 AND CONNECT IT WITH f = 0.0188 AND READ CORRECT D AT THE INTERSECTION OF THIS LINE ON D SCALE, HERE = 11.87".

IF IT IS DESIRED A NEW f BASED ON THE NEW DIAMETER MAY BE DETERMINED. FOR THIS EXAMPLE NO SIGNIFICANT CHANGE IN f WILL BE DISCOVERED IF ONE RECOMPUTES IT.

Fig. 3—Pipe diameters for minimum investment.

pipe diameter for different petroleum-industry fluids is given by a wide variety of flow formulas in general use in the industry.

Pipe-Line Flow Formulas

D'Arcy-Weisbach—Crude:

$$Q = 4.064 \frac{D^{2.5} P^{0.5}}{S^{0.5} f^{0.5} L^{0.5}}$$

Where f is expressed by the Colebrook-White equation:

$$(f)^{1/2} = \frac{1}{-2 \log_{10} \left[\frac{e}{3.7D} + \frac{2.51}{N_R (f)^{1/2}} \right]}$$

$$N^R = \frac{92.24Q}{D\nu}$$

Hazen-Williams—Products:

$$Q = \frac{0.148 D^{2.63} P^{0.54} c}{S^{0.54} L^{0.54}}$$

Miller's—Products:

$$Q = \frac{4.06 D^{2.5} P^{0.5}}{S^{0.5} L^{0.5}} \ln (D^3SP/\mu^2 + 4.35)$$

T. R. Aude—Products:

$$Q = \frac{20.9 D^{2.66} P^{0.552} K}{S^{0.448} L^{0.552} \mu^{0.104}}$$

Where:

- Q = rate, in barrels of 42 U. S. gal. per day.
- D = inside diameter of pipe, in in.
- P = pressure drop, in psi. per mile.
- S = specific gravity of liquid.
- f = D'Arcy - Weisbach friction factor, dimensionless.
- L = length of pipe line, in miles.
- e = height of protuberances on inside pipe wall, in in.
- N_R = Reynolds number, dimensionless.
- ν = kinematic viscosity, in centistokes.
- c = Hazen-Williams friction factor.
- μ = absolute viscosity, in centipoises.
- K = T. R. Aude's friction factor, pipe efficiency.

Most texts on hydraulics quote the D'Arcy-Weisbach[4,10] as the more versatile equation. In past years the biggest drawback to the D'Arcy equation was the absence of data on the friction factor. Many investigators sought to express this friction factor f in terms of internal roughness or the Reynold's number.

Notable among these investigators were von Karman,[5] Nikuradse,[7] and Prandtl.[9] An empirical equation based on analytical and experimental data is the Colebrook-White[3] equation which is a combined expression of the formulas developed by the previously mentioned three gentlemen. The Colebrook equation is asymptotic to the smooth and rough pipe laws and follows experimental values in the transition region.

The biggest drawback to the Colebrook equation is that it cannot be solved explicitly for friction factor f. This may be circumvented by plotting f against the Reynold's number. Then, when the Reynold's number is known, f may be determined easily.

Universal equation . . . We have the impression that the D'Arcy-Weisbach equation is used more universally than any of the other equations. Therefore, one of the nomograms which follows is based on it. In addition, a plot of the Colebrook equation has been worked into the nomogram for convenience in the determination of f.

Based on limited data on our crude and products pipe lines, we obtained the following values of e (height of protuberances on the inside pipe wall) in the Colebrook equation: old 8.25-in. crude service, e = 0.0035 in.; old 12.250-in. products service, e = 0.0020 in.; and new 12.250-in. products service, e = 0.00093 in.

Prof. L. F. Moody[6] recommends the use of e = 0.0018 in. This is the value which we used to letter the diameters shown on the f-curve plot on the nomogram. As we pointed out, the data used to determine our values of e were meager. The crude oil shipped in the 8.25-in. pipe varied in makeup, and no laboratory data of the actual value of its viscosity existed. The new 12.250-in. pipe was too short to obtain accurate pressure-drop readings. The old 12.250-in. pipe was long enough to give fairly accurate pressure drops and, for this reason, we feel that it is most reliable of the three. This latter value seems to bear out Professor Moody's value.

The Hazen-Williams formula,[11] an original water formula, has been modified and used widely for products pipe-line computations. However, its value is somewhat limited because of the absence of viscosity factor. The performance of products lines which handle a wide range of products such as kerosine and distillate, as well as butane and propane, in addition to the usual varieties of gasoline, cannot be accurately predicted with this formula.

Miller's equation is in use by at least one major pipe-line company. It is said to give quite satisfactory results, although its use requires the prior preparation of a series of curves in order to solve explicitly for pressure drop.

The T. R. Aude formula,[1] presented to the Division of Production's Symposium on Internal Corrosion of Products Pipe Lines, at the 1943 annual meeting of the American Petroleum Institute, is employed by at least three companies. Aude pointed out to us that his equation was derived from data collected on 6-in. and 8-in. pipe in products pipe-line service and should be used advisedly for other sizes.

There is a large number of other formulas employed by pipe-line companies, most of which are empirical and are restricted to a limited range of diameter, type of pipe, product handled, or rate of flow. Many pipe-line companies have special adaptations of some of the foregoing formulas, which adaptations are modified to suit their particular needs.

Derivation of Formula for Minimum Investment

As previously stated, the foregoing formulas give the relation between pressure drop and pipe diameter when the pumping rate and the physical properties of the product are known. For the D'Arcy-Weisbach equation this relationship is as follows:

$$P = 0.06054 Q^2Sf/D^5 \qquad (3)$$

Where:

- S = specific gravity of liquid.
- f = D'Arcy - Weisbach friction factor, dimensionless.

Therefore, Equation 2 can be rewritten as follows:

$$I = [C_1 (D) + C_2 (0.00001701 PQ/\eta)] L$$

$$I = [C_1 (D) + C_2 (0.000001030 Q^3Sf/D^5\eta)] L \qquad (4)$$

The principle of maxima and minima requires that the first derivative be taken and set equal to zero. We shall do this for the diameter with respect to the investment.

$$dI/dD = [C_1 + C_2 (-0.000005150 Q^3Sf/D^6\eta)] L = 0 \qquad (5)$$

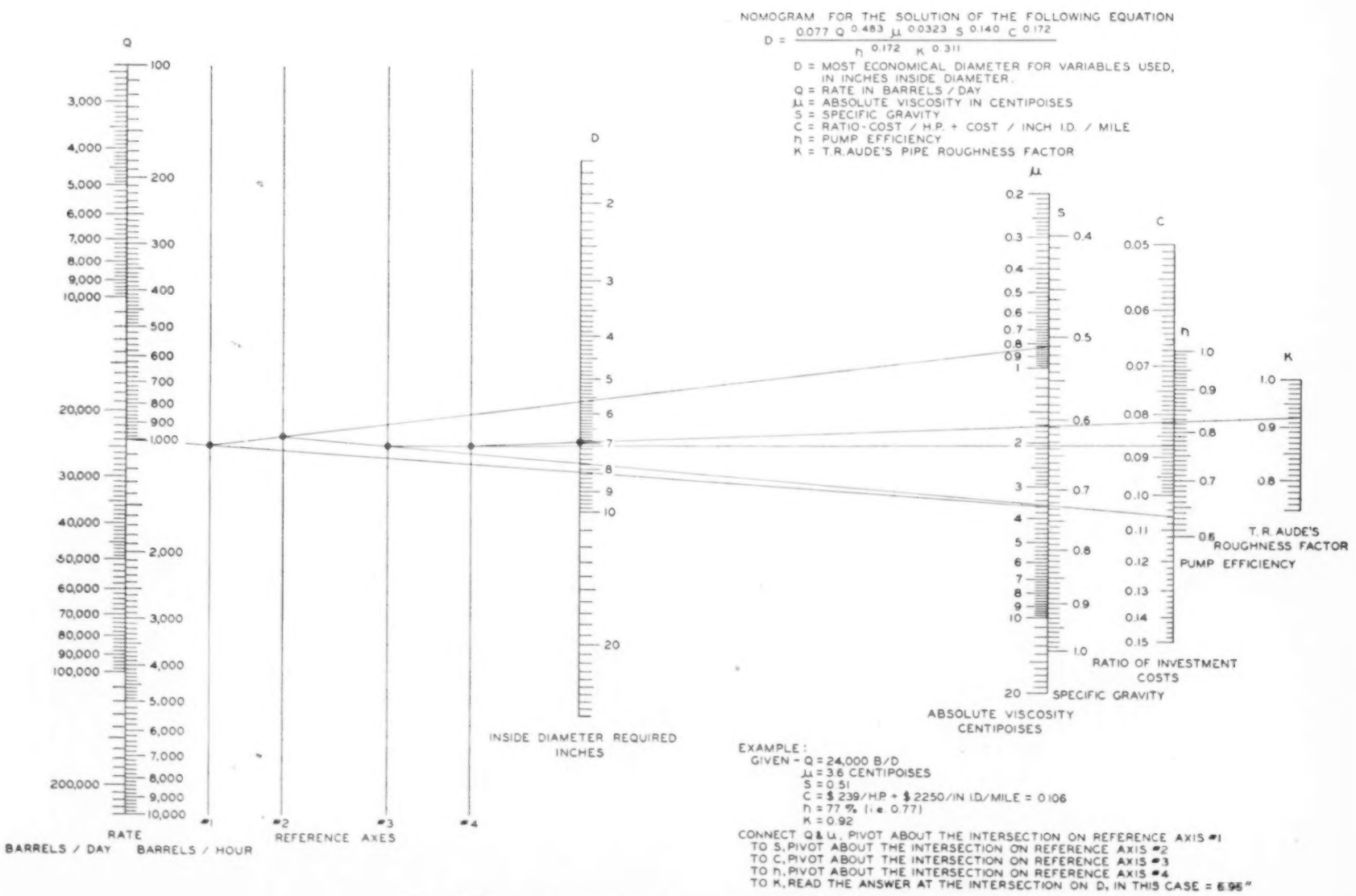

NOMOGRAM FOR THE SOLUTION OF THE FOLLOWING EQUATION
D = 0.077 Q^0.483 μ^0.0323 S^0.140 C^0.172 / η^0.172 K^0.311
D = MOST ECONOMICAL DIAMETER FOR VARIABLES USED, IN INCHES INSIDE DIAMETER.
Q = RATE IN BARRELS / DAY
μ = ABSOLUTE VISCOSITY IN CENTIPOISES
S = SPECIFIC GRAVITY
C = RATIO - COST / H.P. + COST / INCH I.D. / MILE
η = PUMP EFFICIENCY
K = T.R.AUDE'S PIPE ROUGHNESS FACTOR
Q
RATE
BARRELS / DAY
BARRELS / HOUR
D
INSIDE DIAMETER REQUIRED
INCHES
#1
#2
#3
#4
REFERENCE AXES
μ
ABSOLUTE VISCOSITY
CENTIPOISES
S
SPECIFIC GRAVITY
C
RATIO OF INVESTMENT COSTS
η
PUMP EFFICIENCY
K
T. R. AUDE'S ROUGHNESS FACTOR
EXAMPLE:
GIVEN - Q = 24,000 B/D
μ = 3.6 CENTIPOISES
S = 0.51
C = $.239/H.P. + $.2250/IN I.D./MILE = 0.106
η = 77 % (i.e. 0.77)
K = 0.92
CONNECT Q & μ, PIVOT ABOUT THE INTERSECTION ON REFERENCE AXIS #1
TO S, PIVOT ABOUT THE INTERSECTION ON REFERENCE AXIS #2
TO C, PIVOT ABOUT THE INTERSECTION ON REFERENCE AXIS #3
TO η, PIVOT ABOUT THE INTERSECTION ON REFERENCE AXIS #4
TO K, READ THE ANSWER AT THE INTERSECTION ON D, IN THIS CASE = 6.95"

Fig. 4—Pipe diameters for minimum investment, based on T. R. Aude's formula.

Solving for D:

$$D = (0.000005150\ Q^3SC_2f/C_1\eta)^{1.6}$$

$$= 0.131\ Q^{0.500}\ (SCf/\eta)^{0.167} \quad (6)$$

Where:

$$C = \text{the ratio } C_2/C_1 \frac{\text{(investment per horsepower)}}{\text{(investment per inch of inside diameter per mile)}}$$

A second derivative of Equation 4 yields a plus answer and proves that Equation 6 gives values of D which make I a minimum amount.

By the use of the Hazen-Williams equation instead of the D'Arcy-Weisbach formula, Equation 6 becomes:

$$D = 0.368Q^{0.486}\ (SC/\eta)^{0.170} \times 1/c^{0.315} \quad (7)$$

Similarly, if the T. R. Aude formula is employed, the resulting diameter for minimum investment is expressed as:

$$D = 0.077\ Q^{0.483}\ S^{0.149}\ (C/\eta)^{0.172} \times \mu^{0.0323}/K^{0.311} \quad (8)$$

Any formula for pipe-line flow may be substituted in place of Equation 3, provided it can be solved explicitly for pressure drop. Thus, expressions similar to Formulas 6, 7, and 8, may be derived by the use of any desirable flow equation, provided it meets the foregoing restriction.

Nomograms for the Solution of Minimum-Investment Formulas

We have prepared nomograms to aid in the solution of Equations 6 and 8, Figs. 3 and 4, respectively. Fig. 3 constitutes the nomogram for the D'Arcy-Weisbach equation. To illustrate the use of this nomogram, the following examples are given:

Suppose it is desired to pump 62,400 bbl. per day of western Kansas crude oil. At shipping temperature the gravity = 40.3° A.P.I. and the viscosity = 42.5 S.U.s. What size line should be constructed to permit doing this for the minimum investment?

Thus:

Q = 62,400 bbl. per day.
S = 40.3° A.P.I. or 0.824 sp. gr.
ν = 42.5 S.U.s. or 5 centistokes.

For the particular locality we are considering the cost-estimating section submits a cost for pipe installed equal to $2,500 per inch of inside diameter per mile. Similarly they submit a cost of $250 per horsepower for the type of pumping units and stations which we are considering.

Thus:

$$C = 250/2,500 = 0.10$$

With the knowledge of which type of pumping units we are going to install, from past experience we can estimate their efficiency at 77 per cent (η = 0.77, or 77 per cent).

On the subject of f, we know it will be less than 0.025 from an inspection of the f-curve plot.

Solve as follows:

Connect Q = 62,400 bbl. per day, on the nomogram in Fig. 3, to S = 40.3° A.P.I. with a straight line, and mark the intersection of this line on reference axis No. 1. Use this mark on reference axis No. 1 as a turning point, connect it with C = 0.10, and mark the intersection of this line on reference axis No. 2. Use this mark on reference axis No. 2 as a turning point and connect it with η = 77 per cent, marking the intersection of this line on reference axis No. 3. The mark on reference axis No. 3 should be definitely marked, as it is used at least twice. Connect the mark on reference axis No. 3 to f = 0.025 and read the result at the intersection of this line on the D scale, here equal to 12.23 in.

Friction factor . . . If it is desired to check the estimated friction factor f, connect the D just determined with ν = 42.5 S.U.s., and mark the intersection of this line on the special axis. The point on the special axis is then connected to Q = 62,400 bbl. per day on the inverted Q scale. From the intersection of this line on the N_R scale, proceed horizontally across the curves until at D = 12 in., and read f = 0.0189. Until the point on reference axis No. 3 once again, connect it to f = 0.0189, and read the correct D = 11.67 in. If it is desired, the f based on this diameter may be computed. Here no noticeable difference from 0.0189 will be discovered.

Twelve-inch pipe, of course, would be the nearest commercial size which we would employ in this case. Schedule 20 12-in. pipe would give an inside diameter of 12.250 in.

If the fluid in the example problem were liquefied petroleum gas instead of crude oil, e.g., propane, and the remaining data were unchanged, then the minimum-cost diameter computation would be as follows:

Q = 62,400 bbl. per day of propane.
S = 0.51 sp. gr.
ν = 0.22 centistokes.
C = 0.10.
η = 77 per cent, or 0.77.

A diameter of 10.25 in. would be the result with an f = 0.014 in. We would probably use 10.750 in. o.d. Schedule 20 pipe, which has a 10.250-in. i.d. diameter.

The example points out that, for minimum investment, one size larger pipe is required for the crude oil than for propane, all other parameters remaining constant.

Exact result . . . The result which the nomogram yields is "exact" for the parameters used. In few problems will this exact answer correspond to a commercially available size of pipe. By remembering that the values used to obtain the exact size are the conditions to be expected, we can make the following statement.

The selection of a commercially available size of pipe should be the nearest size larger than the exact size. The reason is as follows: A smaller pipe than the exact size will give a higher investment, as will a larger pipe; but the smaller pipe generally will have higher operating costs than the larger pipe. Furthermore, if the rate of flow is increased—which is the more common experience—it would cost still more to pump through the smaller pipe than it would through the larger pipe.

The nomogram for solution of Equation 8 which is based on the T. R. Aude formula is handled in a very similar manner to the foregoing except that the efficiency factor is employed instead of the roughness factor, and solutions may be handled directly without refinement of the f value, as is necessary in connection with the D'Arcy-Weisbach formula. It should be pointed out that the viscosity shown in Fig. 3 is kinematic viscosity expressed in centistokes or Saybolt Universal seconds, whereas the viscosity shown in Fig. 4 is absolute viscosity expressed in centipoises.

Adjustment for Inclusion of Operating Costs

These examples make no allowance for costs of operation of the pipe-line facilities. Numerous investigators in the past have made studies which took these factors into account.

Allowance can be made for the inclusion of operating costs in these for-

(Continued on page 319)

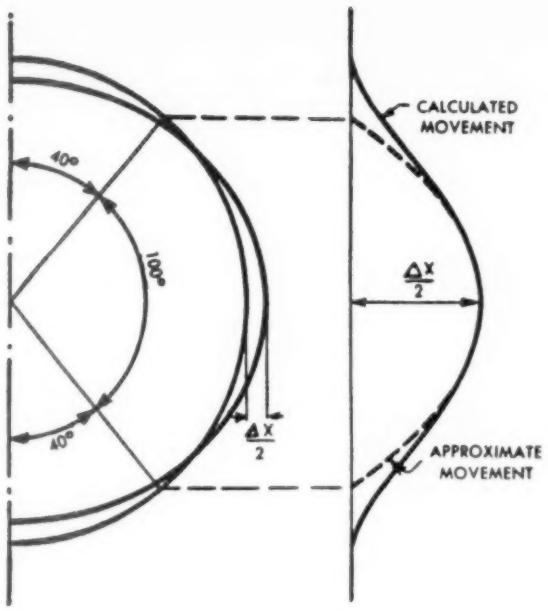


Fig. 1—The horizontal movement of the sides of a circular ring when it is deformed into an ellipse.

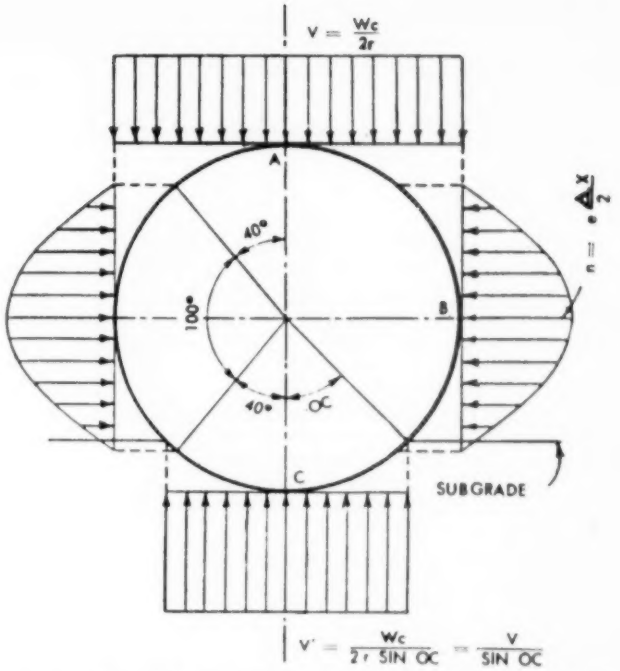


Fig. 2—The distribution of pressures around a flexible under an earth fill.

Here's how to design

Flexible Protective Casings for Pipe Lines

Electronic calculators can be used to advantage in these calculations, as well as for solution of many other complicated and time-consuming pipe-line design and operating problems

by E. A. Slade

THE electronic calculator can be used to advantage in the design of pipe casings by the Spangler method. This method, now recommended by the A.P.I. Subcommittee on Pipe - Line Crossings, has proved satisfactory in a number of installations to date. Its adoption would reduce the problems now encountered in casing design.

Electronic calculators can also be used in pipe-line operations to:

- Periodically determine the operating capacity of a line under a wide range of operating cost factors.
- Calculate oil-run tickets, crude-oil payments, and divisions of interests involved in the purchase and transportation of crude oil.

For additional data on the use of electronic calculators in the solution of pipe-line problems, and throughout the oil industry, refer to The Oil and Gas Journal, February 2, 1953, "Special Section on Electronic Computers in the Oil Industry."

Committee work . . . Compilation of data by the crossings subcommittee based on information furnished by 10 major pipe-line companies covering several thousand casing installations (dating back to 1918) discloses that there has never been a structural failure of any installed casing using ordinarily available line pipe for casing in diameters from 6 in. through 30 in. of standard wall thicknesses.

In view of the recommended adoption of Spangler's data and method of computation of flexible casings, the author set out to develop a set of curves which could be adopted as the recommended A.P.I. design for casings under Cooper's E-70 loading, plus 75 per cent impact. (The weight of a Cooper's E-70 locomotive is 497,000 lb. The length of the locomotive is 52 ft. and length of ties is 8 ft. This results in a unit soil load of 2,090 lb. per sq. ft.)

Casing Design Theory

Appropriate portions of Professor Spangler's paper are given as follows to acquaint readers of this paper with the design theory without having to refer to the complete paper:

"Protective casing pipes are subjected to loads caused by the earth embankment above it and the traffic over the rails. Results of researches carried out by Spangler and the Iowa Engineering Experiment Station in cooperation with

Author is maintenance superintendent, Service Pipe Line Co., Tulsa. Paper presented before session on transportation, annual A.P.I. meeting, Chicago, November 10.

the U. S. Public Bureau of Roads have an important bearing on this problem. A suggested procedure for the structural design of flexible pipe-line casing is presented."

Spangler states that:

". . . flexible pipes are capable of withstanding relatively very large deflections without rupture of the pipe wall or other evidence of structural damage, as compared to rigid conduits made of concrete and burned clay.

"This ability of a flexible pipe to deform readily and thus utilize the passive resistance pressure of the soil on each side of the pipe is its principal distinguishing structural characteristic. Also, inasmuch as flexible pipes fail by excessive deflection rather than rupture of the pipe wall, a method of structural design should be directed toward predetermining the deflection of the pipe under specified conditions of installation and loading. Tests conducted in the Iowa Engineering Experiment Station laboratory indicate that the elastic theory is applicable for determining the deflections of flexible pipes within the elastic range of the metal."

Spangler also concludes, based on Iowa Engineering Experiment Station research over a 40-year period, that:

". . . the soil over a conduit produces vertical load on the structure in accordance with Marston's conduit-load theory, and that this load is approximately uniformly distributed over the top of the structure; also that traffic loads applied at the ground surface are transmitted down to the structure approximately in accordance with the Boussinesq theory of stress distribution in an elastic medium."

Loading conditions . . . Spangler also states that:

". . . in general, a flexible metal pipe under an embankment load deforms from a circular to an elliptical shape with the minor (vertical) axis of the ellipse less than the diameter of the circle by the amount of the vertical deflection, and the major (horizontal) axis greater than the original diameter by the amount of the horizontal deflection. This horizontal deflection results in horizontal movement which builds up passive pressures on each side of the pipe proportional to the movement.

"This loading condition is shown graphically in Figs. 1 and 2. With a load hypothesis established, it is possible . . . to develop a mathematical expression for the horizontal deflection of a flexible pipe in terms of the load,

Soil	Nom. Size	Pipe Size Diam. B_d	Radius	R	I_x	R/B_d	C_d	Under Radical Value	Cube Root	
1	20	1667	10000	2	240	1200	100	09053	2084	1502
1	20	1667	10000	3	220	1800	128	07682	1973	1422
1	20	1667	10000	3	220	1800	128	07682	1973	1422
1	20	1667	10000	4	200	2400	153	06226	1840	1327
1	20	1667	10000	5	180	2999	173	04633	1667	1202
1	20	1667	10000	6	160	3599	191	02982	1439	1038
1	20	1667	10000	7	155	4199	204	02269	1314	0947
1	20	1667	10000	8	140	4799	215	01500	1145	0825
1	20	1667	10000	9	130	5399	224	00675	0877	0632
1	20	1667	10000	10	110	5999	232	01250E	1077E	0776E
1	20	1667	10000	11	100	6599	238	02159E	1292E	0932E
1	20	1667	10000	12	095	7199	242	02584E	1372E	0989E
1	20	1667	10000	13	090	7798	246	03011E	1444E	1041E
1	20	1667	10000	14	080	8398	249	04002E	1588E	1145E
1	20	1667	10000	15	075	8998	251	04484E	1649E	1189E
1	20	1667	10000	16	070	9598	253	04966E	1709E	1230E
1	20	1667	10000	17	065	10198	255	05448E	1759E	1268E
1	20	1667	10000	18	060	10798	255	05985E	1815E	1309E
1	20	1667	10000	19	057	11398	255	06308E	1848E	1332E
1	20	1667	10000	20	053	11998	255	06738E	1889E	1362E
1	20	1667	10000	21	050	12597	255	07060E	1918E	1383E
1	20	1667	10000	22	049	13197	255	07168E	1928E	1390E
1	20	1667	10000	23	048	13797	255	07275E	1938E	1397E
1	20	1667	10000	24	044	14397	255	07705E	1975E	1424E
1	20	1667	10000	25	043	14997	255	07813E	1984E	1430E

Fig. 3—A page of tabulated results obtained in solving Equation 2 using the I.B.M. 604 electronic calculator.

the properties of the pipe, and the properties of the soil at the sides of the pipe:

$$\Delta X = \frac{K W_c r^3}{EI + 0.061\, er^4} \qquad (1)$$

Where:

ΔX = immediate horizontal deflection of pipe, in.

W_c = vertical load on pipe, pounds per lineal inch.

"The moment of inertia of the cross-section of the pipe wall per unit length of the pipe is one-twelfth the cube of the wall thickness. If we let t equal the wall thickness, in inches, and substitute $t^3/12$ for I in Equation 1, an expression for the wall thickness in terms of a specified deflection, the vertical loads, and the properties of the pipe and of the soil may be obtained:

$$t = [I/E\ (12\, Kw_c r^3/\Delta X - 0.732\, er^4)]^{1/3} \qquad (2)$$

r = radius of pipe, in.

E = modulus of elasticity of pipe metal, psi.

I = moment of inertia of cross-section of pipe wall, in.^{4} per in.

e = modulus of passive resistance of side-fill soil, psi. per in.

K = a parameter which is dependent upon the bedding angle.

"A phenomenon of considerable interest which was revealed in the experimental studies is the fact that flexible pipes continue to deflect slowly and for a long period of time after the maximum load from the overlying embankment has been reached. This continuing deflection has been called 'deferred deflection,' and is not re-

Soil	Nom. Size	Pipe Size Diameter B_d	R	I_x	C_d	t	ΔX_i	Stress
3	24	2000	2	240	106	250	1147	33986
3	24	2000	3	220	141	250	1107	32765
3	24	2000	4	200	173	250	1063	31478
3	24	2000	5	180	199	250	1011	29959
3	24	2000	6	160	221	250	955	28241
3	24	2000	7	150	242	250	939	27780
3	24	2000	8	140	263	250	923	27352
3	24	2000	9	130	281	250	904	26758
3	24	2000	10	110	300	250	843	24974
3	24	2000	11	100	317	250	822	24347
3	24	2000	12	95	333	250	821	24334
3	24	2000	13	90	348	250	819	24251
3	24	2000	14	80	360	250	792	23458
3	24	2000	15	75	369	250	782	23179
3	24	2000	16	70	379	250	774	22930
3	24	2000	17	65	387	250	763	22585
3	24	2000	18	60	393	250	749	22204
3	24	2000	19	57	399	250	744	22035
3	24	2000	20	53	404	250	734	21713
3	24	2000	21	50	410	250	729	21577
3	24	2000	22	49	414	250	729	21620
3	24	2000	23	48	417	250	729	21597
3	24	2000	24	44	419	250	715	21143
3	24	2000	25	43	422	250	714	21153
3	24	2000	26	42	424	250	713	21096
3	24	2000	27	41	425	250	710	21007
3	24	2000	28	40	427	250	708	20950
3	24	2000	29	39	429	250	706	20927
3	24	2000	30	36	433	250	699	20691

Fig. 4—A page of tabulated results obtained in solving the stress equation using the I.B.M. 604 electronic calculator.

vealed by Equation 1. If it is desired to include deferred deflection in the calculation of pipe deflection, Equation 1 can be empirically modified by multiplying it by a factor called the deflection lag factor.

Thus:

$$\Delta X_1 = \frac{D_e K W_c r^3}{EI + 0.061 e r^4} \quad (3)$$

Where:

ΔX_1 = ultimate long-time deflection of the pipe.

D_e = deflection lag factor.

$$\Delta X_1 = \Delta X D_e \quad (4)$$

"A very limited amount of experimental evidence indicates that a conservative value of the deflection lag factor is in the neighborhood of 1.25 to 1.50.

"It is believed that Equation 1 or the modified form, Equation 3, can be used to predetermine the deflection of a flexible protective casing pipe at railroad crossings and serve as a means of choosing casing-pipe thickness which will prevent excessive deflection. . . . The load situation in casing installations would be typical of the class of conduits described by Marston as "ditch conduits." The formula for load on a ditch conduit is:

$$W_d = C_d w B_d^2 \quad (5)$$

Where:

W_d = load on conduit, lb. per lineal foot.

w = unit weight of soil, lb. per cu. ft.

B_d = width of ditch or, in this case, the width of bored hole, ft.

C_d = a coefficient which is a function of the ratio H/B_d and of the coefficient of internal friction of the soil above the pipe.

H = height of fill above the top of pipe, ft."

Solution of Problem

The solutions of Spangler's Equations 2 and 3 were cumbersome and, by conventional methods using desk calculators, slide rule, and logarithms, each solution consumed about an hour of an engineer's time.

The petroleum industry, as well as all industry, has been faced with an acute shortage of engineers during the past decade. Ever-increasing pressures have been exerted so that engineers can be used for creative thinking and basic design, leaving the routine problems to others for solution.

To develop useful charts for pipeline-casing design involving these two

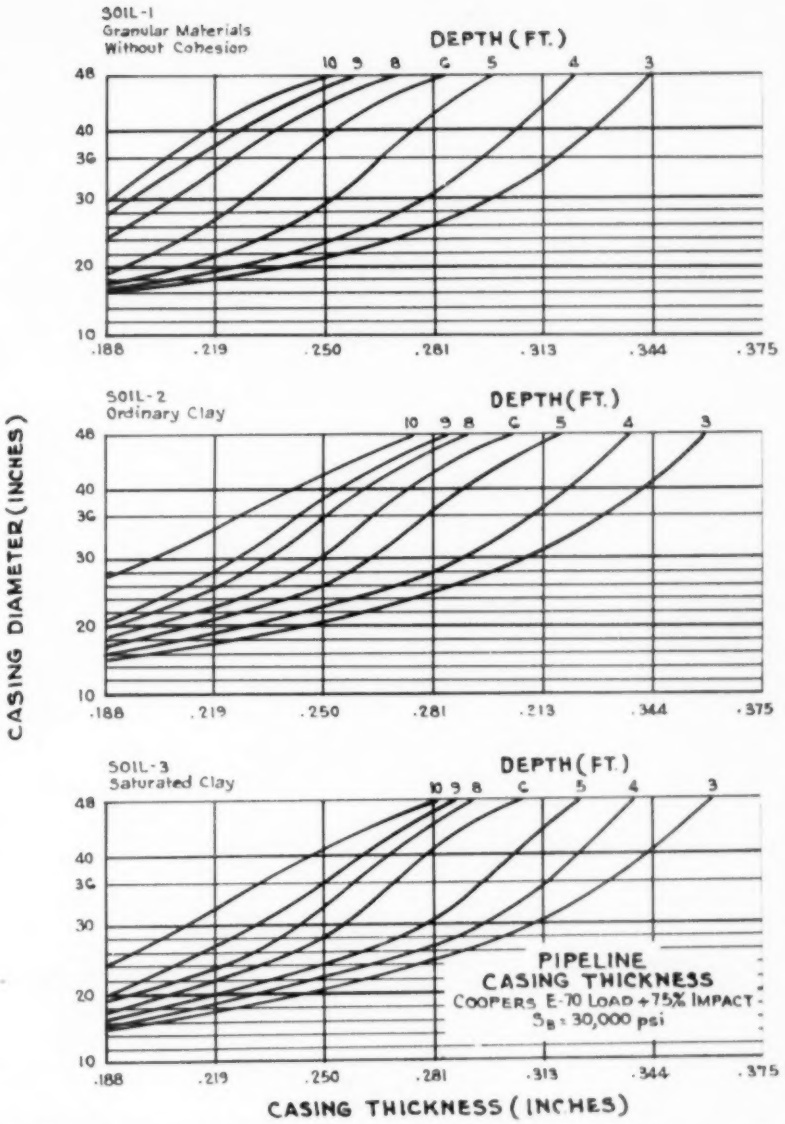


Fig. 5—Required pipe-line casing thickness for various casing diameters in three types of soils.

equations means a prodigious amount of work. The use of electronic calculators was investigated and the formulas were combined and simplified for application to solution by the I.B.M. 604 electronic calculating punch.

The formula derived from Equation 2 in solving the problem is as follows:

$$t = 0.04325\ B_d \times [B_d (C_d B_d + 64.478 I_c - 11.711)]^{1/3}$$

Necessary information . . . Other information required for the solution of the problem consisted of the following:

Sixteen values of pipe diameter—B_d.

Thirty-four values of fill height—H.

Thirty-four values of I_c.

Fifteen values of H/B_d and (C_d) were obtained from Spangler's paper, equally spaced on the curve, for each of three types of soil: (1) granular, (2) ordinary clay, and (3) saturated clay.

Given this information, the following procedure was used in the solving for t:

1. Cards were key-punched for the 16 values of pipe diameter and the 34 values of "fill" and "I_c."

2. These cards were then reproduced and gang-punched until we had a deck of cards with the 34 values of "fill" and "I_c" in each of the 16 values of pipe diameter.

3. H/B_d values were computed and punched in Columns 21-25 of the card.

4. We then reproduced the cards three times and thereby created our basic deck for the three types of soil.

5. C_d values were key-punched for all computed H/B_d values.

6. Since H/B_d values given in the original data did not exceed 15.00, we eliminated cards with computed values above that point so as to insure accuracy in the values of C_d used. All values needed for the solving of the original problem were now available.

All calculating to this point was done on I.B.M. Type 602A calculators; and from this point, the Type 604 electronic calculator was used. The solving of t in the original formula required six passes through the calculator. These were as follows:

1. Solving underneath the radical: $B_d (C_d B_d + 64.478 I_c - 11.711)$.

2. Proving underneath the radical.

3. Four iterations in solving cube root. An original guess of 3.0 was made which was not close enough in all cases to solve the cube root in these four iterations.

4. Second group of four iterations in solving cube root.

5. Cubing of answer secured in Step 4 above. This was also compared against the original number and punched the difference. The greatest difference found was 12/10,000.

6. Multiplying and proving of the values outside the radical:

$$0.04325\ B_d\ (\ )^{1/3}$$

Fast operation . . . This operation was done at the rate of 100 cards per minute. Based on 379 H/B_d values for each type of soil, we used 1,137 cards which passed through the 604 in less than 12 minutes. This speed was constant throughout all operations, so it is apparent that there was very little machine time involved in the computing.

A page of the tabulated results obtained from this operation is shown as Fig. 3. It will be noted that values of t beginning with 10 ft. of fill height H were minus quantities. It was first assumed this meant that casing would not be required, since the bored hole under an embankment without casing would be self-supporting due to the "arch effect" of the soil.

The author has witnessed such conditions during the construction of pipeline crossings where bored holes have stood up without caving for long periods under heavy railroad traffic. However, not being convinced that this would be good practice, even if it were so, further checks were made with Professor Spangler on this theory. The conclusion was reached that an improper approach was made to the problem and that solution for values of actual deflection with assumed casing thickness would have to be obtained.

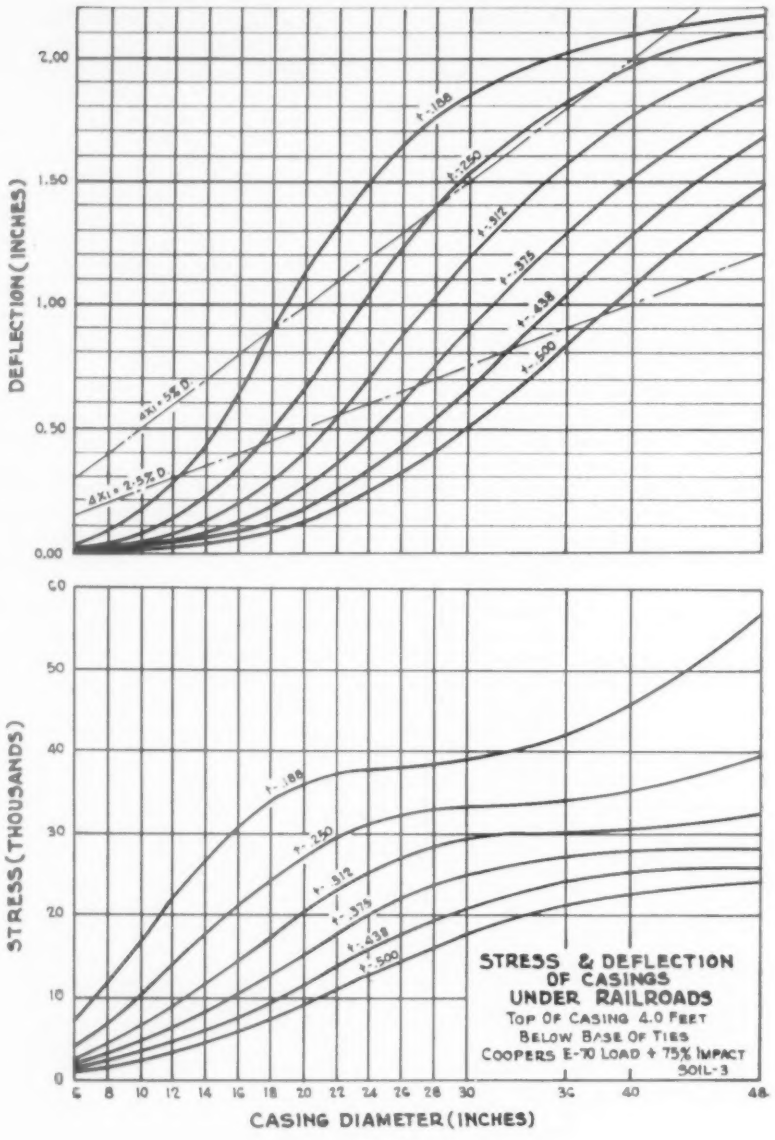


Fig. 6.

Deflection data . . . Arrangements were then made for the electronic calculation of the deflection data for the preparation of the desired curves. This time the calculations were even more prodigious since a greater number of variables and their combinations were required.

In order to make the computations on the 604 calculator, it was necessary to rearrange Equation 3 as follows into a new form which would utilize the known factors:

$$\Delta X_1 = \frac{D_c K W_c r^3}{EI + 0.061\ er^4}$$

Where:

ΔX_1 = ultimate long-time deflection of casing.
D_c = deflection lag factor (1.50).
K = bedding constant (0.09).
r = mean radius of casing inches (½ o.d.).
E = modulus of elasticity (30,000,000).
e = modulus of passive resistance of sidewall (30 psi. per in.)
I = moment of inertia of cross-section of casing wall ($t^3/12$).
$W_c = W_d - W_e$ = vertical load on pipe (lb. per lineal inch).
W_d = earth load on pipe (lb. per lineal inch).

$$W_d = \frac{C_d W B_d^2}{12} = 10.417\ C_d B_d^2$$

Where:

C_d = coefficient from Spangler's paper.
W = unit weight of soil, lb. per cu. ft. (125).
B_d = width of bored hole (casing diameter, ft.).

Substituting and reducing to lowest terms:

$$\Delta X_1 = \frac{0.1281\ B_d^4\ (C_d\ B_d + 66.90\ I_c)}{1{,}054\ t^3 + B_d^4}$$

This equation was conveniently handled by the computer.

In the solution for ΔX_1 the following factors were involved:

3—soil types
34—fill heights (H)
16—diameters of pipe (B_d)
11—pipe-wall thicknesses (t)

This required a theoretical total of 17,952 solutions of the equation. Due to limiting values of the ratio, H/B_d to 15.00, the total solutions were reduced to about 13,500. The 604 calculator performed the calculation in one pass of the cards through the machine since many of the values had been previously computed and were transferred to the new deck by means of the gang-punching technique.

The normal speed of the 604 is 6,000 solutions per hour but, due to the full machine program required for the solution of this equation, it was necessary to reduce the machine speed to 3,000 solutions per hour. At this rate the 13,500 solutions were completed and tabulated on 528 pages in a period of about 4½ hours. By ordinary means of solution with desk calculators this problem would have required about 3,500 man-hours.

Data plotting . . . The plotting of the data obtained from this series of calculations into a useful form using fill height, H, pipe diameter, D, wall thickness, t, and deflection, ΔX_1, would require the making of 48 charts, one for each type soil and each of the 16 pipe diameters. Such a presentation of data was not thought practical for this paper, and the amount of work involved in making the plots could not be tolerated.

It was also apparent after a review of the tabulated data that deflections of 2 in. plus would be obtained in the larger-diameter casings of thinnest wall section. This made it imperative that the stress in the casing be determined.

A solution was desired to the problem involving the stresses developed in casing under railroad loadings. A review of the literature furnished the author by Professor Spangler indicated that his paper, "The Structural Design of Flexible Pipe Culverts," presented at the seventeenth annual meeting of the Highway Research Board, Washington, D. C., 1937, and published in Public Roads, Vol. 18, No. 12, February 1938, pages 217-231, offered a solution for the stress by use of the flexure formula and Equation 3 of the above-mentioned paper.

Substituting the known parameters, used in solution of Equations 1 and 3, resulted in the following equation:

$$S = 51.84\ B_d^2/t^2 \times (C_d\ B_d + 66.90\ I_c - 6.917\ \Delta X_1)$$

Where:

S = stress in casing (psi.).
B_d, C_d, I_c, ΔX_1, and t as before.

This equation was set up in the 604 computer on October 21, 1953, and values of stress were computed in 2½ hours by rerunning the 13,500 cards previously obtained in the solution for deflection. The results of both computations were then tabulated. One page of the 528 pages of tabulated values is shown in Fig. 4.

Tabulated data . . . The tabulated data obtained from this last computation was used as the basis for developing curves which will be useful to pipe-line engineers and others in design of casing installations for undercrossing railroads.

The curves presented are based on a maximum allowable fiber stress of 30,000 psi., which is within the accepted range of design stress for presently available standard types of pipe made of mild steel and the various other grades of pipe under A.P.I.-5LX specifications.

Data Interpretation

The three sets of curves shown on Fig. 5 are representative of those derived from the computed values. These curves show effects of the three types of soil: (1) granular, (2) ordinary clay, and (3) saturated clay, on the wall-thickness for a given diameter and depth at a stress of 30,000 psi. Spangler says that flexible casings can be safely stressed up to one and one-half times the elastic limit, since they fail by excessive deflection rather than by rupture of the casing wall.

Since the curves in Fig. 5 are based on a bending stress of only 30,000 psi., they represent conservative values. Only bending stresses have been considered in these curves; thrust and shear stresses also occur, but are too small for consideration. There is no shear stress at the bottom of the pipe where the moment is the greatest.

For 22-in. o.d. casing at 6-ft. depth, a wall thickness of 0.219 in. in required in granular soil. A thickness of 0.234 in. is required in saturated clay. This increase in wall thickness is due to the greater load on the casing through a soil that is plastic and acts more like a fluid.

It is apparent from these curves that a 48-in. o.d. casing having 11/32-in. (0.344-in.) wall thickness is not stressed more than 30,000 psi. under the greatest soil load transfer condition, at a depth of 4.5 ft. below the base of rail (4.0 ft. below base of ties). This is the minimum depth recommended in A.P.I. Code 1102.

Most pipe-line companies use casings that are 4 in. larger in diameter than the oil carrier pipe. The largest-diameter crude-oil trunk line installed by any company to date is 30 in. o.d. A 34 or 36-in. diameter casing for this line, stressed to 30,000 psi. maximum at a depth of 4 ft., would require a wall thickness of ⅜ in. (0.313 in.). This is a standard wall thickness manufactured by most pipe suppliers.

Smaller diameters . . . In the smaller diameters of casing, 22-in. o.d. and less, a wall thickness of ¼ in. (0.250 in.) would be adequate for all casing installations made in accordance with A.P.I. Code 1102. It is pertinent to note that carrier pipes, manufactured of Grade B steel under A.P.I. Specification 5L with 35,000-psi. yield, in diameters of 16-in. o.d. and larger, of less than ¼-in. wall thickness, are seldom installed. This is due to pressure requirements.

Pipe in these large diameters remaining after trunk-line construction is usually available in pipe-line-company warehouse stocks, and is suitable for future casing installations.

An examination was made of the computed values for casings smaller than 16-in. o.d. and wall thickness of ⅜ in. (0.188 in.) installed in saturated clay 4.5 ft. below the base of rail. This examination shows that the casing will not be stressed over 30,000 psi. and will not deflect more than 0.650 in. under Cooper's E-70 load plus 75 per cent impact.

This is shown graphically in Fig. 6. These curves also show that a deflection of 5 per cent of the casing diameter will not be exceeded in casings of 14-in. (0.250-in.) wall, except in the range between 28 and 38-in. o.d. The computed deflection values for this range of diameters and wall thickness

(Continued on page 319)

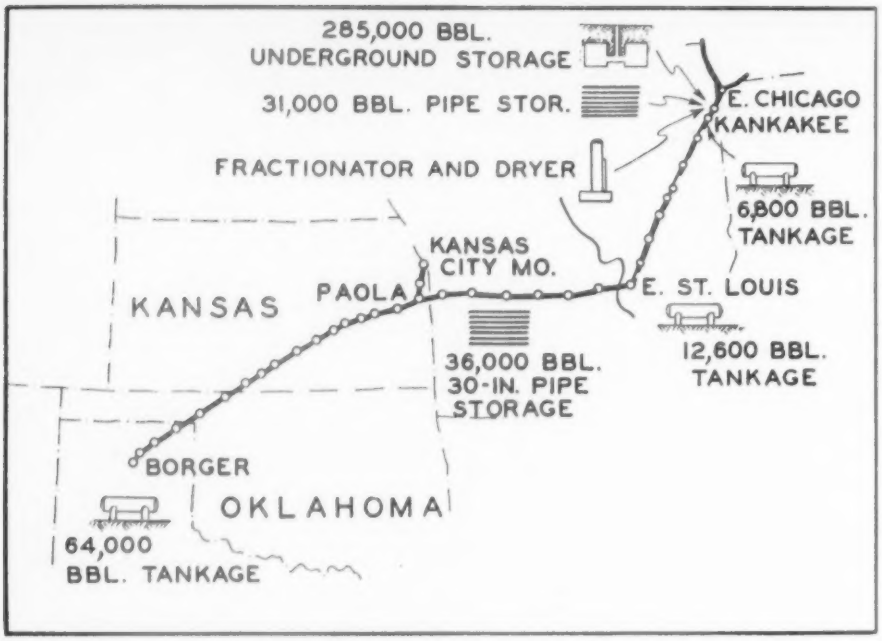


Fig. 1—Products transportation system and connected shipper-owned propane facilities of Phillips Pipe Line Co.

How to Transport and Store Propane On a Products Pipe-Line System

- Storage facilities include (1) conventional above-ground storage, (2) underground pipe storage and (3) mined underground storage.
- Pumping equipment consists of conventional centrifugal pumps with mechanical seals. Station back pressures must be closely watched to keep the propane in a liquid state at all times.
- The critical product specification of residue is maintained by the use of butane buffers and proper scheduling of products.
- It is believed that propane transportation by pipe lines which connect large sources of L.P.G. with concentrated markets will increase in the near future.

by J. W. Boyd,
J. O. Richardson,
and
D. A. Roach

PHILLIPS PIPE LINE CO. has transported propane as a finished product in its 950-mile Borger, Tex., to East Chicago, Ind., products pipe-line system since June 26, 1952. Approximately 1,500,000 bbl. of propane has now been transported through this line in tenders ranging in size from 25,000 to 55,000 bbl. at 10-day intervals.

Problems in Moving Propane

Propane is a unique product to be transported in a conventional products pipe-line system for several reasons.

1. Unlike gasoline or distillates, propane requires a moderate pressure to liquefy and to maintain as a liquid. At 100° F., propane has an approximate vapor pressure of 190 psi.

2. Propane generally requires expensive pressure storage which is usually constructed in multiple, small-capacity units. If favorable underground formations are available, underground caverns or mines may prove practical at reduced costs.

3. Propane has a low specific gravity of about 0.51 which affects the performance of centrifugal pumps.

4. Propane is highly compressible. At 60° F., a pressure change of 1,000 psi. will compress propane about 3.8 per cent. This compares with the compressibility of 0.8 per cent for gasoline and 0.6 per cent for kerosine.

5. Specifications for most uses require a product of high purity. Extreme product dryness is also necessary.

6. Present demand for propane is extremely seasonal. With minimum storage, this could result in high peak loads for pipe lines transporting propane.

Products System

Propane originates at the Borger facilities of Phillips Petroleum Co. The shipper has 64,000 bbl. of propane tankage at this location. Typical tenders may run as high as 55,000 bbl., though

Authors associated with Phillips Pipe Line Co., Bartlesville, Okla. Paper presented before session on transportation, annual A.P.I. meeting, Chicago, November 10.

our tariff describes a minimum tender of 25,000 bbl. Propane is received into the system at this location at a 60,000-bbl. per day rate. Butane is used as a buffering material on each tender. The shipper's needs for butane, such as sale to L.P.G. customers and blending in motor fuel, are such that it is customary to precede a propane tender with 10,000 to 15,000 bbl. of butane and to follow the propane with about 5,000 bbl. of butane.

As shown in Fig. 1, the shipper has 36,000 bbl. of storage located at Paola, Kans., where heart cuts of propane are taken. The propane arrives at Paola completely on specification. Heart cuts are also taken at East St. Louis, Ill., where the shipper has 12,500 bbl. of aboveground tankage. Propane also arrives at this location completely on specification.

After East St. Louis takeoffs, the remaining propane product, together with the butane-propane mixtures in the buffers, is transported on to Kankakee, Ill., where the pipe-line stream is taken into a 285,000-bbl. underground cavern owned by the shipper. The pure butane portion of the buffer is taken on to East Chicago. To provide specification propane at Kankakee, the product is fractionated and any butane contained is separated. The specification propane is stored in aboveground tanks ready for loading into tank cars and trucks.

This outlines in general the travel of a propane tender in the Phillips Pipe Line Co. system. Certain other specific points involved in propane handling are worthy of mention.

Product Specification

For the two critical specifications of dryness and residue the product must pass a combined residue and oil-stain test to pass sales specification. To perform this test, a 1,000-cc. sample is allowed to evaporate or "weather" at a final temperature of 100° F. Only ½ cc. of nonevaporative residue can remain. This represents a maximum contamination of 1 part in 2,000. This residue must pass a test for oiliness performed by pouring the residue through a filter paper without producing an oil stain. We believe that meeting the requirements of this test is the most critical part of pipe-line handling.

Residue . . . As shown in Fig. 1, Phillips Pipe Line Co. has two separate pipe lines from Borger to St. Louis. One pipe line, designated as the "B" line, handles only lighter products, such as natural gasoline, butane, aviation gasoline, motor fuel and propane. These products leave no oily residue on the pipe walls which the propane tender can dissolve. You will notice from the same map this system from St. Louis to East Chicago consists of an 8-in. line with long partial loops. This line also handles distillate products. Unless a propane tender is preceded by a long tender of gasoline or butane, there is some possibility that the leading part of the propane tender will absorb the oily residue from the pipe wall. If such occurs, this residue is removed by the fractionation operation at Kankakee.

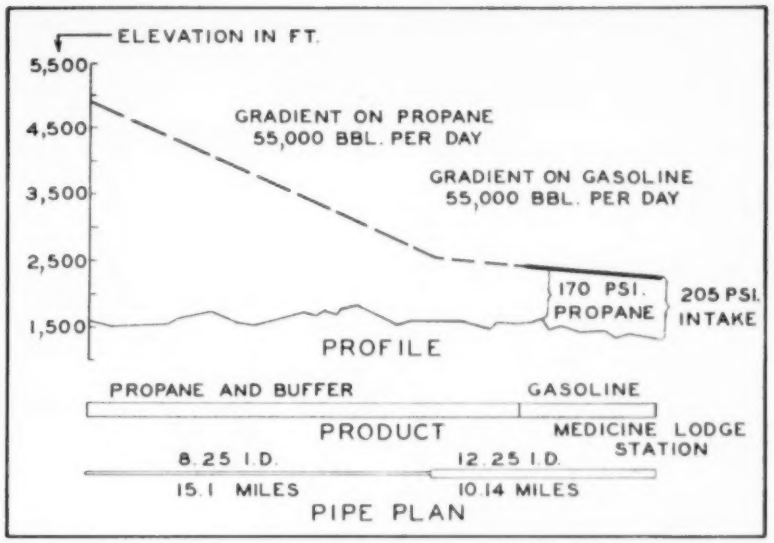


Fig. 2—Hydraulic gradient illustrating intake pressure to be maintained on propane at Medicine Lodge station.

Dryness . . . The other critical specification mentioned is dryness. Salable propane must pass the cobalt bromide dryness test which permits a maximum water content of 20 p.p.m. This is generally not a problem in our system because all products are dehydrated before entering the pipe line. Since this is a critical specification we have a small dehydrator at Kankakee which can be used for emergency drying. Most propane is dried upon manufacture and thus has a high affinity for any water which might be included in the pipe line.

Main-Line Pumping Equipment

All pumps used for handling this product are multistage, centrifugal pumps with mechanical seals. Nearly all these pumps are engine driven and range in size from 250 to 1,500 hp. Normal station discharge operating pressures range from 1,050 to 1,200 psi. Prior to propane handling, we had successfully used a conventional metallic-type packing lubricated by forced-feed lubricators. This type of packing did not prove satisfactory for propane handling and all pumps were equipped with mechanical seals. These seals have given very satisfactory results.

Because of the low gravity of propane, centrifugal pumps produce less differential when handling propane than when handling gasoline or heavier material. With engine-driven units this can be partially compensated for by slightly higher engine speeds. Phillips on its Borger-Denver products system has successfully used positive-displacement pumps with lubricated packing when handling propane at discharge pressures as high as 1,500 psi. This system has handled propane since 1947.

Station Back Pressure

One pumping problem is the necessity of maintaining sufficient pressure at the intake of each station to keep the propane in a liquid state, not only at the station intake but also at points upstream where the line may be at higher altitude which can drop the pressure below the propane vapor pressure. This is further illustrated in Fig. 2.

To prevent such an occurrence, charts have been prepared for each section advising the station as to the correct back pressure to maintain based on the expected arrival time of the propane in the station. An example of these charts is given (Table 1).

Pumping capacity . . . The necessity of carrying high back pressures and the lower head developed by centrifugal pumps on propane results in a slight reduction in pipe-line capacity. These two are partially offset by favorable

TABLE 1—TYPICAL MINIMUM INTAKE CHART FOR PROPANE—MEDICINE LODGE

Rate 50,000 to 54,000 Bbl. Per Day

	Product temperature			
Hours out	45-54	55-64	65-74	75-84
2 to 0	165	185	205	230
4 to 2	165	185	205	230
6 to 4	M	M	120	145
8 to 6	M	M	M	M

Rate 55,000 to 60,000 Bbl. Per Day

	Product temperature			
Hours out	45-54	55-64	65-74	75-84
2 to 0	165	185	205	230
4 to 2	165	185	205	230
6 to 4	M	M	M	M
8 to 6	M	M	M	M

Note: At all rates below 50,000 bbl. per day and regardless of temperature the minimum intake will be 240 psi. from 8 hours out until tender passes Medicine Lodge.

M—Minimum, depends on product preceding propane.

friction characteristic of propane. The amount of this reduction varies with the length of the propane tender and the line fill and topography between stations.

Tankage and Storage Facilities

All terminal propane facilities, such as storage, loading docks, connecting lines, and fractionating facilities are owned by the shipper, Phillips Petroleum Co., who has given permission to describe some of these facilities now in use.

Tankage at the Borger origin point and at East St. Louis consists of aboveground tanks of approximately 1,400-bbl. capacity per tank. Borger has a total of 64,000 bbl. of such storage and East St. Louis has 12,600 bbl. These tanks are 10 ft. 6 in. in diameter and 110 ft. 3 in. long.

Gaging . . . This is accomplished by a conventional ground-reading, float-type gage installed near one end of the tank. At Borger, when a tender of 50,000 bbl. is received, it is sometimes necessary to withdraw from as many as 45 tanks. This, of course, results in a considerable amount of work in gaging and calculating tanks.

Pipe storage . . . Due to the steel shortage when propane facilities were first constructed, storage at Paola and Kankakee was constructed of 30-in. diameter pipe. At Paola, there are forty-two 30-in. pipe tubes, each 1,143 ft. long, which are manifolded in batteries of six each with an approximate capacity of 5,000 bbl. per battery. These tubes were coated for corrosion protection and laid side by side with a slope downhill of about 35 ft. from back to front. A 2-ft. thick layer of earth was placed on top of the tubes.

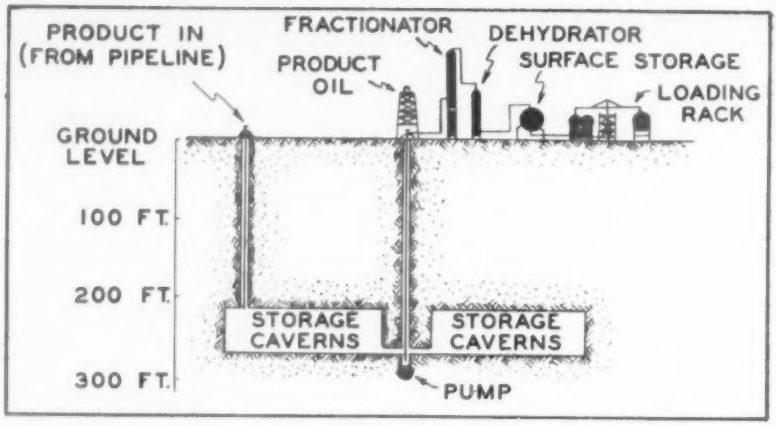


Fig. 3—Schematic of the underground L.P.G. storage at Kankakee, Ill.

These tubes are gaged by a differential gage which indicates the difference in pressure between the lower and upper end of the tube caused by the static head of the propane in the tube. In addition, for checking purposes, slip-tube gages are installed at the midpoint and higher end of the tubes.

At Kankakee a similar pipe installation consisting of forty-four 30-in. tubes, approximately 970 ft. long is in use. These are manifolded into seven batteries of six tubes each with a capacity of approximately 4,200 bbl. per battery, and one battery of two tubes having a capacity of 1,400 bbl. These batteries are laid with a slope of only 2 ft. back to front with 2 ft. of earth cover. Each battery is connected to a 6-ft.-high gage pot in which a conventional float-type, ground-reading gage is installed. A small amount of conventional aboveground tankage is also located at Kankakee.

Mined cavern . . . The third storage installation at Kankakee consists of an underground cavern mined by conventional mining methods from a shale formation approximately 215 ft. below the ground. The excavation of this cavern was accomplished by sinking a shaft to the level of the shale formation followed by mining separate rooms from the shaft.

Storage capacity of this cavern is approximately 285,000 bbl. It is equipped with a float-type gage read at ground level. Cavern temperatures are determined with thermocouples. Product is removed by pumps located in the shaft. One unit is a submersible pump and motor, while the other is of the conventional deep-well type, driven by a motor at the top of the shaft. Only one of these pumps is used for operations, with the other as a standby. In operation, propane is taken from the pipe line directly into the mine. Product from the mine is pumped to the fractionator from which it is stored in the aboveground tanks for loading. This operation is shown schematically in Fig. 3. The fractionator boilers are fueled by vapors withdrawn from the top of the mine.

Loading Facilities

Facilities to load both tank cars and trucks are located at all storage sites. All loading pumps are of deep-well, centrifugal type which eliminate "gassing up" or "vapor locking." All loading is done through a two-line system in which both a liquid delivery line and a vapor line are used. Product is not metered to either tank cars or trucks. All liquid lines at loading docks contain an excess flow valve immediately upstream from hose connections. Trucks are loaded at approximately a 200-g.p.m. rate. This means that the usual truck can be loaded in about 25 minutes. Loading of propane into either tank cars or trucks is more time consuming than loading conventional products due to increased connection time, slower loading rates, and necessity of close supervision by loader. All propane loaded is stenched with ethyl mercaptan or Calodorant during the loading process, unless the purchaser directs otherwise.

Special Safety Equipment

Facilities at Paola, East St. Louis, and Kankakee are protected by remote-controlled, internal, hydraulic valve systems. These internal valves are located on tank outlets and in other strategic locations in the terminal piping. A small hydraulic system supplies pressure to hold these internal valves in an open position. Each internal valve

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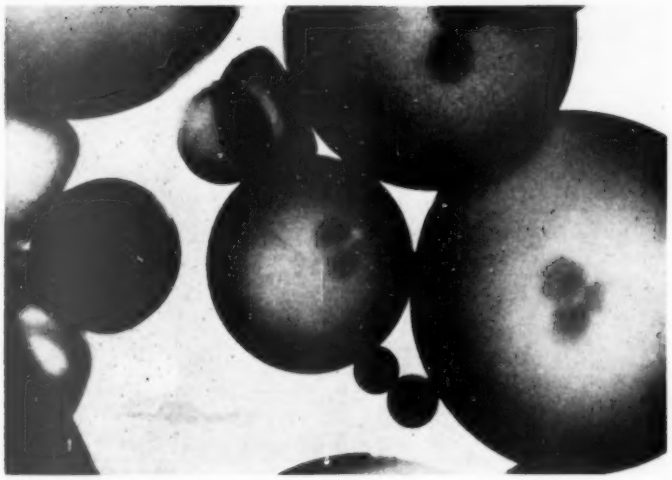
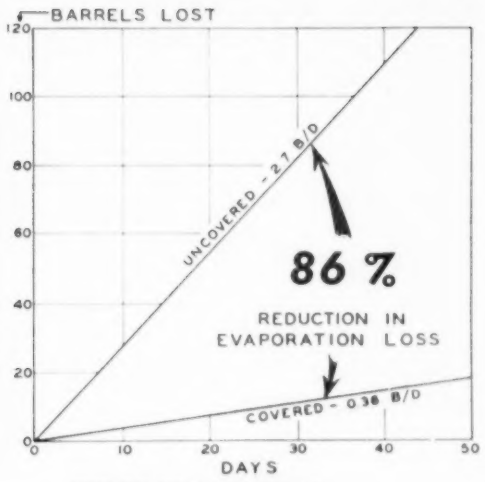


TINY BALLOONS . . .



. . . BRING BIG SAVINGS

New Foam Cuts Evaporation Losses

by E. G. Ellerbrake* and F. Veatch†

ONE-YEAR payouts are possible when crude-oil evaporation losses in storage are retarded with the use of a new inert foam called "Microballoons." The technique consists of floating a layer of microscopic, hollow plastic spheres on the liquid surface in a tank.

The fluidity of the layer enables it to pass around supports, swing lines, and other "dead wood" in the tank while keeping the liquid surface sealed as the level moves up and down, thus acting as a fluid floating roof. Field test data show evaporation-loss reductions above 80 per cent for a variety of conditions, as given in Table 1.

An accompanying figure gives the reduction in evaporation loss experienced by Standard Oil Co. (Ohio) when a 25,000-bbl. tank was covered with a layer of the foam (86 per cent).

Economics . . . The original problem which led to the development of Microballoons was the very high stock losses experienced in old wood-roof tankage used for dead storage. A special study of losses in 20 of these 25,000-bbl. tanks over a period of 9 months indicated an average loss of 1,000 bbl. per tank per year.

If the 83 per cent reduction due to the installation of Microballoons (Table 1) is applied to the 1,000-bbl. per year loss, the predicted saving with a foam covering would be 830 bbl. annually. With crude-oil values at $3.00 per barrel, the annual saving would be approximately $2,500. The cost of installing a ½-in. Microballoon covering on this size tank would be $2,200, as shown in Fig. 1.

The use of the A.P.I. nomographs would predict a total annual evaporation loss of 1,800 bbl. for a 55,000-bbl. cone-roof tank under the following conditions:

Average R.v.p., psi.	5.0
Tank dimensions, ft.	100 by 40
Average liquid temperature, F.	60
Average outage, ft.	20
Number of fillings per year	25
Total annual throughput, bbl.	1,300,000

The predicted breathing loss would be 1,100 bbl. per year and the filling loss 780 bbl. per year. While the test results have not differentiated the effect of a foam covering between breathing and filling losses, the over-all loss reduction in working-tank tests was similar to the reduction in static-tank tests and was in the neighborhood of 83 per cent. Thus, a similar tank under the above conditions with a Microballoon seal should have a total annual loss of approximately 320 bbl.

The resulting saving with crude oil at a value of $3.00 per barrel would be $4,700 per year as compared to the cost of installing Microballoons of $2,600.

Small-tank economics . . . On a 10,000-bbl. tank it might be desirable to install an automatic shutoff valve to safeguard against the loss of the foam covering when the tank is pumped out. This would increase the foam installa-

*Sohio Pipe Line Co., and †Standard Oil Co. (Ohio). Presented before annual meeting, American Petroleum Institute, November 9.

TABLE 1—EVAPORATION-LOSS REDUCTIONS USING MICROBALLOONS

(A foam thickness of ¾ to 1 in. shows a greatly reduced evaporation loss under a variety of conditions of tank size, operation, and crude-oil vapor pressure)

Types of test and tank conditions—	Crude-oil R.v.p.	Loss rates (gal./1,000 sq. ft./day) Control	Foam covered	Per cent rate reduction
Static:				
1,000-bbl. open vent	3.3	10.4	1.5	85
40-bbl. conservation vent	5.2	8.5	1.3	85
40-bbl. conservation vent	7.3	10.0	2.6	74
Worked:				
40-bbl. conservation vent	5.2	7.7	0.2	97
40-bbl. conservation vent	8.5	15.2	*4.6	*70
25,000-bbl. open vent	3.0	17.1	2.2	86
Average per cent loss reduction				83

*Estimated by vapor analysis.

tion cost of $900 by another $200. In a 10,000-bbl. bolted tank with a diameter of 55 ft. and a height of 24 ft., the annual breathing loss would be 240 bbl. and the annual filling loss 200 bbl., under the following conditions:

Average R.v.p. of crude, psi.	4.5
Average outage, ft.	13
Average oil temperature, °F.	55
Annual number of fillings	55
Annual throughput, bbl.	550,000

The estimated annual loss reduction with Microballoons would be 83 per cent, resulting in an annual saving of approximately 365 bbl., or $1,095 with $3.00 per barrel crude oil against the $1,100 installation cost.

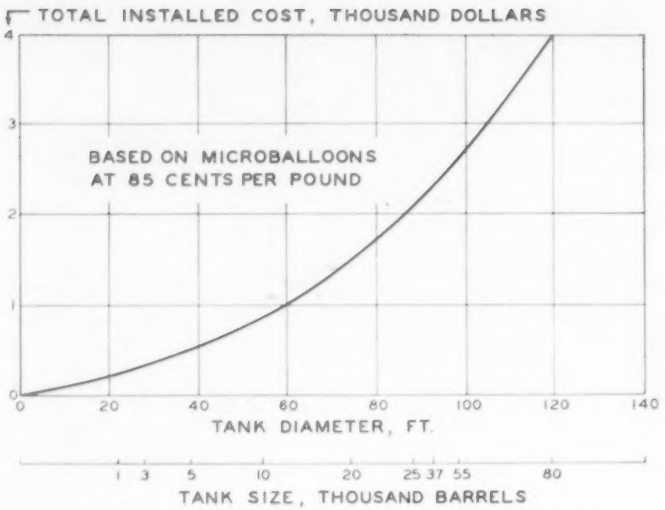


Fig. 1—Cost of a ½-in. Microballoon seal on various size tanks.

Fire hazard with tanks . . . On normal cone-roof tanks vapor measurements have indicated that an explosive vapor exists whenever a crude-oil tank is being pumped out and for many hours thereafter. During the remainder of the time, when the tank is full or being filled, the vapor is usually too rich to explode. It is estimated that the vapor in normal crude-oil working tanks is probably in the explosive range from 25 to 50 per cent of the time.

Sufficient results are not available on tanks covered with Microballoons to indicate what per cent of the time the vapor of such tanks is in the explosive range. However, measurements have shown that with the Microballoon covering on tanks with open vents, the vapor will be too lean to support a flame a large percentage of the time.

The majority of foam coverings which have been installed on tanks to date have been on tanks which were in static storage use and did not have vaportight roofs. The vapor in these tanks was always in the explosive range prior to the installation of Microballoons. Following the installation, the vapor remained below the flammability limit. Since the normal vaportight tank is in the too-rich range most of the time, it may be wise to remove the vents, or keep them open ofter installing Microballoons.

Installation . . . The most practical method of installing Microballoons on tanks which are in service has been found to be pumping them in, mixed with crude oil. This is accomplished by the use of a hopper mounted on top of an aspirator. The aspirator which has been used is one which is commonly employed in chemical-foam fire-fighting systems. The pumping equipment consisted of a 150-bbl. per hour rotary pump driven by a gasoline engine.

With this equipment it is possible to install Microballoons on a 90-ft.-diameter tank in approximately 3 hours. The aspirator and hopper can be connected so the oil and Microballoons are pumped into the regular inlet or through a hose into the top of the tank. The oil required for the aspirator can be obtained from another tank or from the tank on which the foam covering is to be installed.

A pressure of approximately 100 psi. was required on the aspirator inlet to give the required velocity on the outlet of the nozzle. It was possible to add up to 20 lb. of Microballoons per minute to the oil, resulting in a fluid slurry of Microballoons in crude oil.

Only 400 to 500 bbl. of oil is necessary to pump 3,000 lb. of Microballoons into a tank. This would be enough particles to form a ½-in. layer on a 90-ft.-diameter tank.

Other methods . . . A number of other methods for installing the material have been tried. One was a farm elevator of the type commonly used for filling silos. Although this device worked quite well, there is metal-to-metal contact between the elevator trough and the buckets carrying material up to the trough, and danger of a spark igniting the vapor in the tank. Such an elevator could probably be made safe by eliminating the metal-to-metal contact near the tank opening.

Another method considered but not tried was a blower of the type used to install insulation in homes, with which the foam covering could be installed in a very short time. However, the friction caused by blowing the particles into the tank with air might build up enough static charge to cause a spark inside the tank. On new or gas-free tanks, the use of an insulation blower might be the most economical method.

There are other methods which could be used, one of which is merely carrying the Microballoons in their paper shipping bags to the tops of the tanks and emptying them into a tank opening.

An advantage of pumping the Microballoons into the tank with crude oil is that the foam spreads evenly over the surface of the oil and is saturated with the crude oil immediately. When dry Microballoons are dumped on the surface of the crude oil, the foam tends to be quite thick below the point of entry and relatively thin on other parts of the tank but with sufficient time will spread out to a uniform layer. It is probably advisable to use a spray or some other method of stirring the surface to form a more nearly even layer, as evaporation is appreciably reduced almost immediately after installation of the foams.

Gaging tanks . . . The method of gaging Microballoon-covered tanks is practically the same as present practice, except for adding a gage well on the gage line. One practical gage well used consists of a 1-in. copper tube 8 in. long on which is mounted a copper float. When the gage line is lowered into the tank, the plumb bob will penetrate the foam and the whole apparatus continues on down into the crude oil until the gage well floats. Microballoons are eliminated from the surface of the oil inside the float well allowing a sharp reading on the gage line.

Small quantities of Microballoons floating on the surface of a thermometer well do not cause any errors in

(Continued on page 322)

Aerial view of Rice Institute, Houston, looking east across the campus.

Does College Make an Engineer?

No, says this educator. But it prepares his mind for the practical experience which makes engineers

by Dr. W. V. Houston

IN recent years it has become customary to regard a university training as important for an engineer, but this has not always been the case. Engineering work has been done for thousands of years, and only for some 150 of them has it had any formal connection with universities. For several centuries the universities of Europe and the engineers of Europe had no connection with each other. Probably there are still a few practical men who look with considerable suspicion on a university graduate as he comes to an engineering job; and there are probably also a few university people who regard engineering departments as interlopers.

Engineering has two aspects and two traditions. One is the tradition of the master craftsman. It is a little hard to trace, historically, for its members rarely wrote books. They were builders and doers, rather than thinkers and talkers. But they did develop a strong sense of professional responsibility. Mistakes could not be tolerated. The art was handed down from master to apprentice and the road to mastery involved hard work. Experience was its measure.

The other tradition is a scientific and mathematical one. It is represented in ancient times by Plato's academy and by the school at Alexandria. At the time of the Renaissance it comes to light in the faculties of philosophy in the universities and in the mathematicians attached to various courts. Today it is represented by the scientific and mathematical aspects of work in the universities. The men of this tradition were often, and are sometimes today, dismissed as merely theoretical, or impractical, by those who have had less understanding of the matters in which they find such an absorbing interest. But from this group have come most of the strikingly new ideas of engineering.

And when men from this group have been able to establish close and sympathetic relationships with men of experience, engineering has leaped forward with great bounds.

The author is president, Rice Institute, Houston. Paper presented before production session, annual meeting of A.P.I., Chicago, November 10.

The author proposes that colleges should contribute to the general education and scientific background of prospective engineers rather than to their engineering experience. The engineering experience should be obtained in practical engineering situations. As an example of this university program, Rice Institute teaches basic scientific courses throughout the 4 usual university years and, along with these, the student becomes acquainted with broad humanistic problems through English, history, modern languages, etc. In the third year the student gets his first engineering courses, and in the fourth year a distinction between courses is made with respect to the four major branches of engineering covered at Rice.

At the end of this 4-year course students are granted a bachelor of arts degree which serves as a background for a great number of activities in which scientific training is a help. If, after 4 years, a student wishes to continue in engineering as a profession, a fifth year of training is available in specialized engineering studies. After this year a student is granted a degree of bachelor of science.

This program gives a general engineering background, but does not provide for the necessary practical experience. It is suggested that some sort of engineer's internship should be developed to furnish such experience.

A.P.I.—Engineer Training

First ocean cable . . . One story which I enjoy because of its emphasis on the importance of the scientific side of engineering concerns the first transatlantic cable. When, a little more than 100 years ago, the land telegraph was put into operation in the United States and elsewhere, it covered, at first, only relatively short distances. Then its range was steadily extended by the use of sensitive relays and better insulation. Soon the idea of laying a cable under water took hold of the imagination, and short lengths were laid successfully.

> ". . . the proper function of a university, and the only function in which a university can be really effective, is to provide the general education and the scientific background against which an engineer can place his experience."

In the early 1850's a company was formed by Cyrus Field in the United States, and a number of financiers in Great Britain, to lay a cable between North America and the British Isles. They gathered together a fair amount of capital, and employed as chief electrician a man with telegraph experience, who had performed experiments which he believed proved the feasibility of transatlantic telegraphy.

By a curious turn of fate, there appeared just at this time a mathematical electrician of Glasgow, William Thompson. Thompson had grown up in the atmosphere of the university, where his father was a professor. He had entered the university himself at an early age, and had then gone on to Cambridge, where he competed for honors in mathematics.

He won only second place, not first, but several of his contemporaries reported that it was his failure to devote himself to routine methods, and his desire to use the originality of his mind, that prevented him from attaining first rank in this rather stereotyped competition. After a brief time of travel in Europe, he was selected as professor of natural philosophy at University of Glasgow, where he continued the work started in Cambridge on the mathematical theory of electricity.

The theory of electricity at that time was far from complete. Maxwell had not yet formulated the electromagnetic field equations, and the concepts with which Thompson worked were based principally on the experiments of Faraday. Nevertheless, he had considered at some length the problem of the transmission of an electric current over a long line. He showed that it obeyed the equations for the flow of heat; that if the circuit was closed at one end, the current at the other end would not build up instantly, but rather slowly, and that the time for it to build up would depend upon the product of the resistance of the line and its capacitance.

Since both of these quantities are proportional to the length of the line, the time necessary to transmit a signal is proportional to the square of the length. When length such as those of the transatlantic cable are under consideration, the delay becomes significant.

Thompson had pointed out these difficulties in a publication and had indicated ways to minimize them. In the first place, he recommended, the conductor of the cable should be made as large as possible, in order to reduce the resistance. Then the insulation of the cable should be made as thick as possible, in order to decrease the capacitance. Furthermore, very sensitive detecting instruments must be used at the receiving end, in order to respond to the initial rise of the current, rather than having to wait until the current has attained to its full value.

Cable design . . . Although these conclusions were published and were the subject of discussion, the chief electrician employed by the Atlantic Telegraph Co. declared that his own experiments proved the effects described by Thompson to be of no major significance. He indicated that one could simply extrapolate from the experience of lines already in existence, and need not bother with higher mathematics.

The situation naturally presented a dilemma to the directors of the company. Most of them were not engineers; and, in particular, they were not mathematicians. They had to decide between the claims of a man with a good deal of practical experience and one whose electrical engineering had been done entirely on paper and in the laboratory. It is easy to understand why they preferred to depend on experience, or what they thought was experience. So the project went ahead.

Nevertheless, a certain number of shareholders in Scotland, perhaps with the traditional Scottish concern for their money, elected young Thompson to the board of directors, where he was able to express his views, even if he was not able to convince the remaining members of the board. Thus, with full warning of the situation and of possible failure, the cable was manufactured and preparations made for laying it. After some mechanical failures, a line was finally laid in the summer of 1858.

At first it seemed to work, or at least so the chief electrician reported. Later developments showed that it had never worked very well; and that, in the effort to get satisfactory results, he had kept increasing the voltage applied at the sending end by means of an induction coil. Eventually, pulses of 2,000 volts or more were put into the cable with the inevitable result that the insulation broke down and the whole thing was useless.

Here was a situation all of the directors could understand. Close to a million dollars of their money was lying at the bottom of the Atlantic Ocean, apparently serving no useful purpose. And so they changed chief electricians and put Thompson in charge.

Cable delayed . . . It took a long time, however, because of the war in this country, because of the difficulty of raising more capital, because of the difficulty of making a new cable to Thompson's rigid specifications. He insisted, in particular, upon setting up a standard of resistance. Such a thing had never been used before. But with it he showed that the copper ordinarily supplied by the manufacturer fluctuated in its electrical properties more than anyone had suspected.

He made elaborate mathematical studies of the forces to which the cable was subject in the process of laying it, and insisted upon a continual check on the insulation and the resistance as the cable was run out of the ship. So eventually in 1865, a satisfactory cable was laid, and communication was established between Ireland and the North American continent, using Thompson's sensitive galvanometer as the detecting device.

One of the pleasantest features of this story is that Thompson received many generous rewards for his work. There is no evidence of the traditional outwitting of the scientist by those who would exploit his ideas. Not only was Thompson paid well from the income of the Atlantic Telegraph Co.—so well, in fact, that he soon bought a yacht on which he spent his summers—but he received the thanks of the British Empire in the form of a knighthood and later became Lord Kelvin, one of the great men of his century.

But the problem of interest to us today is how could the directors of Atlantic Telegraph Co. have been en-

(Continued on page 315)

A.P.I. Reports on Its Fundamental Research Program

Here's the advisory committee chairman's report on the over-all program. See following pages for accounts of progress in the individual projects.

by T. W. Nelson*

FOR more than 25 years the American Petroleum Institute has sponsored a comprehensive program on fundamental research on petroleum. One major phase of the program has dealt with the occurrence and recovery of petroleum, and the other with composition and properties.

The Institute began its sponsorship of fundamental research on petroleum in 1926. Initiation of the program had been motivated by a grant of $100,000 per year for 5 years—of which one-half was contributed by John D. Rockefeller, Sr., and the other half by Universal Oil Products Co.

First 5 years . . . The initial program evolved into a series of 41 projects, located at various university and government laboratories. Approximately 40 per cent of the projects were concerned with occurrence and recovery of petroleum, and 60 per cent with composition and properties. Support of the program by the original Rockefeller and U.O.P. grants ended in 1931. Thereupon a special committee appointed to study the problem recommended that the program be continued on a reduced scale—financial support to come from within the Institute. Of the original 41 projects, 3 were selected as best for continuance.

Second period . . . The second phase was launched in 1932 on the basis of an annual expenditure of approximately $30,000. These funds were divided equally between research on occurrence and recovery, and research on the composition and properties of petroleum.

Next 21 years . . . Since 1932 the A.P.I. research program has grown steadily, until it consists of nine projects—at an annual expenditure of $663,000. Approximately 40 per cent is spent on projects concerned with occurrence and recovery of petroleum. Within the same period another five projects were initiated, successfully continued to completion, and then terminated.

At the thirty-third annual meeting of the Institute the fundamental research session is sponsored by the Advisory Committee on Fundamental Research on Occurrence and Recovery of Petroleum. The detailed reports concern the three projects under ACFRORP sponsorship, viz., Projects 37, 47, and 51, as well as the support which this advisory committee renders to supplementary research.

PROJECT 37: Fundamentals of Hydrocarbon Behavior.

Project 37 deals with the volumetric and phase behavior of petroleum hydrocarbons under conditions which simulate those encountered in underground reservoirs. Located at California Institute of Technology, Pasadena, it is under the joint direction of Dr. B. H. Sage and Dr. W. N. Lacey. Currently it is also the oldest of the several ACFRORP-sponsored projects. Throughout its existence it has been a consistent contributor to the petroleum industry of important fundamental data on hydrocarbon phase behavior. The most significant contribution in the project's history has been the discovery and acceptance of the principle of retrograde condensation. Knowledge and understanding of this principle have had a substantial influence on the operation of our petroleum reservoirs.

The 1953 budget for Project 37 is $61,000.

PROJECT 47: Mechanism of Displacement of Oil from Porous Materials.

Currently Project 47 is in two parts, viz., Project 47b: "Microscopic Behavior of Fluids in Porous Systems"; and Project 47d: "Solid-Fluid Interactions as Related to Petroleum Production." Project 47b is located at University of Oklahoma, Norman, under the direction of Dr. A. Chatenever; and Project 47d, at University of Texas, Austin, under the direction of Dr. N. Hackerman.

Significant contributions have already been made by Project 47b during the 4 years of its relatively short existence. It has developed apparatus and methods which make possible the visual examination of a variety of porous flow systems.

Project 47d, concerned with the "wettability" of reservoir rocks, was just started last summer. This is an important field of study in reservoir mechanics, and significant results from this research are anticipated.

The 1953 budget for Project 47 is $43,050—$23,000 for 47b, and $20,050 for 47d.

PROJECT 51: Study of Near-Shore Recent Sediments and Their Environments in Northern Gulf of Mexico.

Project 51 is the largest and most recent of the currently ACFRORP-sponsored projects. Located at Scripps Institution of Oceanography, at La Jolla, Calif., it is under the direction of Dr. F. P. Shepard.

Now in its third year, Project 51 is concerned with a fundamental study of recent sediments of two areas in the northern Gulf of Mexico, viz., one at Rockport, Tex., and one east of the Mississippi Delta in Louisiana. Testing of the hundreds of samples taken from these two areas is done at Scripps and at other universities with specialists on their staff in this type of work.

The importance of a fundamental study of recent sediments was originally pointed out by the Research Committee of the American Association of Petroleum Geologists, which committee proposed that the Institute sponsor such a project.

The 1953 budget for Project 51 is $124,000.

*Socony-Vacuum Oil Co., Inc., New York, N. Y.; chairman, A.P.I. Advisory Committee on Fundamental Research on Occurrence and Recovery of Petroleum. Paper presented at annual A.P.I. meeting, Chicago, November 9.

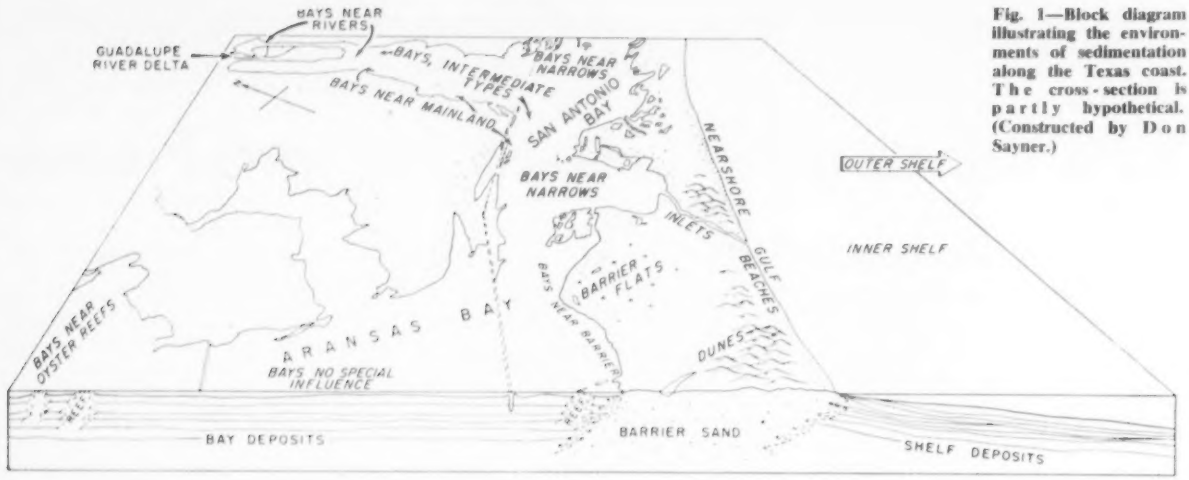


Fig. 1—Block diagram illustrating the environments of sedimentation along the Texas coast. The cross-section is partly hypothetical. (Constructed by Don Sayner.)

A.P.I. RESEARCH PROJECT 51

Guides to Future Oil Traps

. . . indicated by study of near-shore recent sediments and their environments in the Northern Gulf of Mexico

by Francis P. Shepard* and Clarence L. Moody†

About 10 years ago members of the Research Committee of the American Association of Petroleum Geologists made a survey of research needs in the field of petroleum exploration and, in the resulting reports, it was stressed that this approach to the problem overlooked the important possibilities of present-day marine environments where first-hand information on sediments and processes could be obtained. Largely as a result of the efforts of these well-known petroleum geologists, Project 51 was initiated, with the definite purpose of studying the Recent marine sediments in the northern Gulf of Mexico.

PERHAPS one of the most important functions which a geologist can have in both economic and general scientific research is to define the environments in which various sedimentary formations were deposited. In the past interpretations of marine environments have been based almost entirely on studies of the ancient sediments, either those now exposed on land or those brought to the surface by drilling operations.

It has often been said that the stratigraphy of the thousands of feet of sedimentary rocks underlying the Gulf Coast gives indications that conditions of deposition over a long period in the past have been comparable to those which exist at present. The opinion has given special impetus to the work of finding out in detail the nature of sediments which are now accumulating along this coast.

The work on the sediments in this

*Scripps Institution of Oceanography, La Jolla, Calif., and director, A.P.I. Research Project 51. †Ohio Oil Co., Shreveport, and chairman, A.P.I. Research Project 51. Paper presented at annual A.P.I. meeting, Chicago, November 9.

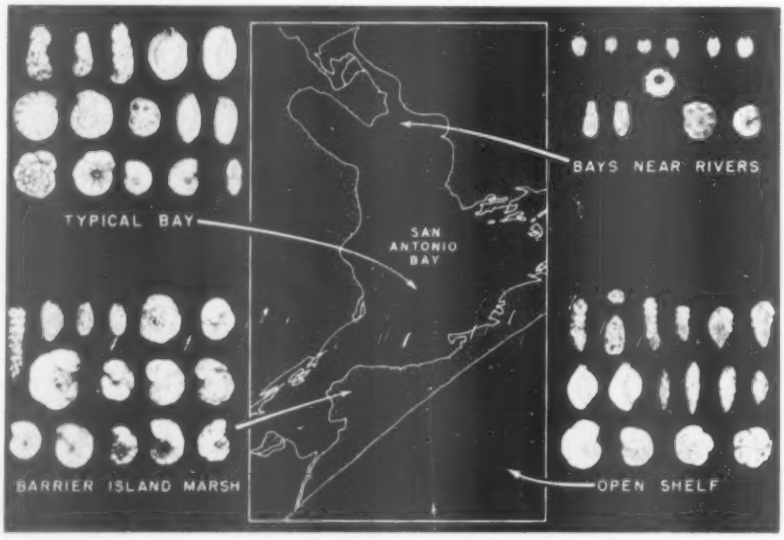


Fig. 2—Foraminifera assemblage characteristic of four Texas coast environments. (Data supplied by Frances L. Parker.)

area, which has now been in progress for 2 years, is by no means the first work of geologists with marine sediments. However, it does represent the first time that a coordinated program with a considerable staff of geologists, chemists, and biologists has been aimed at making an exhaustive study of the environments of deposition and the characteristics of modern sediments in an area where it is highly probable that the sediments of today will become the sedimentary rocks of the future. Furthermore, the project is the first on any appreciable scale which has been focused definitely on discovering the environments in which ancient formations were deposited.

Following the suggestions of the project's steering committee, the first two areas to be investigated have been, respectively: (1) the lagoonal coast of Texas where muddy bays are largely separated from the open gulf by elongate sand islands, and (2) the Mississippi Delta where huge amounts of sediment are being carried directly into the gulf and where the delta is building forward over the ocean bottom at an amazing rate. Inasmuch as it seemed inadvisable to take on a third area simultaneously with the other two, it has been necessary to postpone active work on one very important environment, viz., an area where future limestones and coral reefs are being developed. However, a small fund from the project has been used to encourage the work at the University of Miami on the lime sediments around southern Florida.

Texas Bay and Barrier-Island Environments

An area around Rockport and Aransas Pass along the central portion of the Texas coast was chosen because of the small scale of industrial activities which might contaminate the sediments, the accessibility of the area, and availability of two marine laboratories which could be used as bases for operations and for laboratory space. In this area a total of approximately 900 samples (mostly cores of a few feet in length) has been taken.

Environments defined . . . By the use of results of general geomorphologic observations, and by the use of more than 100 microscopic estimations of the composition of coarse-fraction sievings, 14 different environments have been defined (Fig. 1)—7 of them in the bays, 4 within the barrier islands, and 3 on the Continental Shelf of the open Gulf of Mexico. These include: bays near mainland; bays near rivers; bays near oyster reefs; bays, intermediate type; bays, no special influence; bays near narrows; bays near barriers; barrier flats; inlets; dunes; gulf beaches; near-shore gulf; inner shelf; and outer shelf.

Fig. 3—Present outline of the Mississippi Delta based on recent air photos. The lines A-A' and C-C' refer to sections in Fig. 4.

There is no assurance that all of these environments are of general application to other similar coastal areas, nor even to the adjacent portions of Texas. However, a considerable number of samples has been studied in

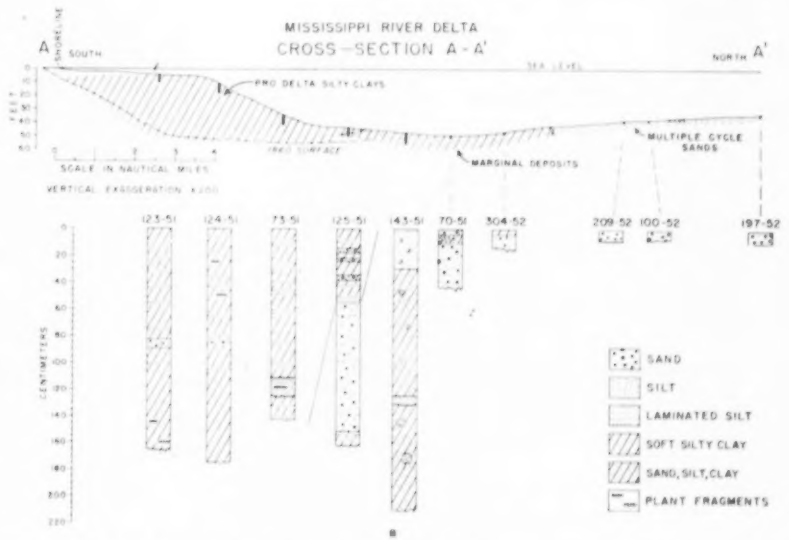


Fig. 4—Cross-sections showing lines of cores obtained transverse in the delta. They illustrate

the areas to the north and east of our project area, and many of the 14 environments have now been recognized elsewhere and have been found to have similar, if not identical, characteristics to those of the Rockport area.

The bay sediments appear to be influenced by entering streams which carry in large quantities of fine sediments and which greatly reduce the salinity of the water. The salinity is particularly important in its relationship to the faunas and, hence, to the fossils which eventually will be found in this environment. The existence of oyster reefs in the bays sometimes is indicated in the sediment, even at considerable distances from the reefs, by the abundance of oyster-shell fragments.* In the portions of bays which are near inlets or narrows where relatively strong currents exist, or which are near the barrier island where there are overwashes during hurricanes, sand is introduced into the otherwise fine-grained sediments, and various organisms are carried in from the open gulf, causing a mixture of the faunas.

In some portions of the bays which lack these special influences, the small amount of sand-sized sediment consists, to a striking extent, of Foraminifera. Nearness to either the mainland or to the barrier islands has a decided influence on bay sediments, principally because the more normal bay sediment is overwhelmed by the sandy material characteristic of the adjacent shore.

On the barrier islands the inner fringes next to the bays are apt to be low swampy areas, partly covered with ponds and channels. The interior of most barrier islands consists of sand dunes derived from the sand beaches. The wind's selective influence, and also the vegetation which grows on or around the dunes, differentiates the dunes from the beach sands on which waves have had a direct influence. A special environment of the barrier islands is provided by the inlet channels which connect the open gulf with the inner bays. Many of these inlets exist only during, or shortly after, a hurricane or other abnormal storm tide, but the hurricanes truncate the growing barrier islands with so many channels, which later become healed, that the deposits in these inlets may be quantitatively very important in the subsequently buried sections of barrier islands.

In the open gulf three different environments have been recognized, although there is no certainty as to whether these environments have sharp boundaries or grade from one to the other. In any case, the deposits near the shores of the gulf are of a definite pattern, and the inner shelf has some characteristics which are different from the outer shelf, with a dividing line at approximately 20 fathoms.

*The possibility exists that commercial oyster-shell dredging has influenced this distribution to an important extent.

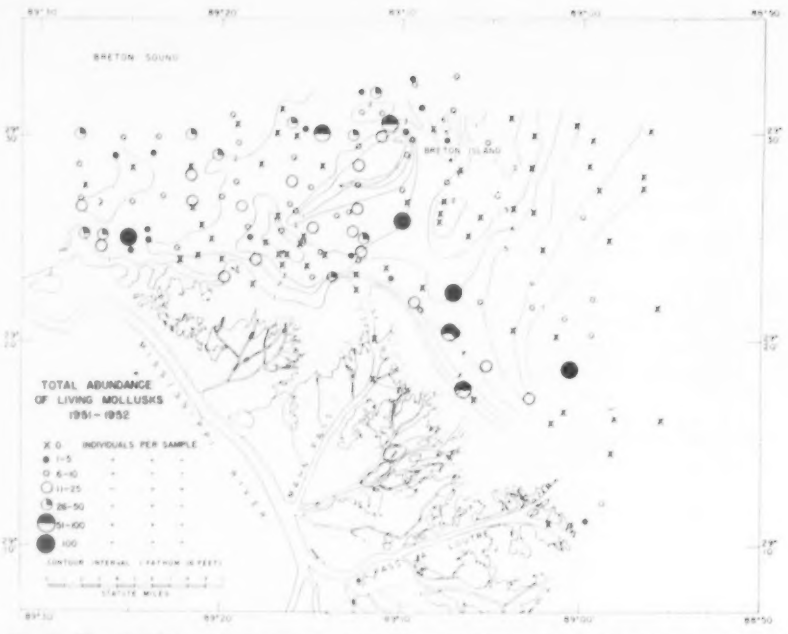
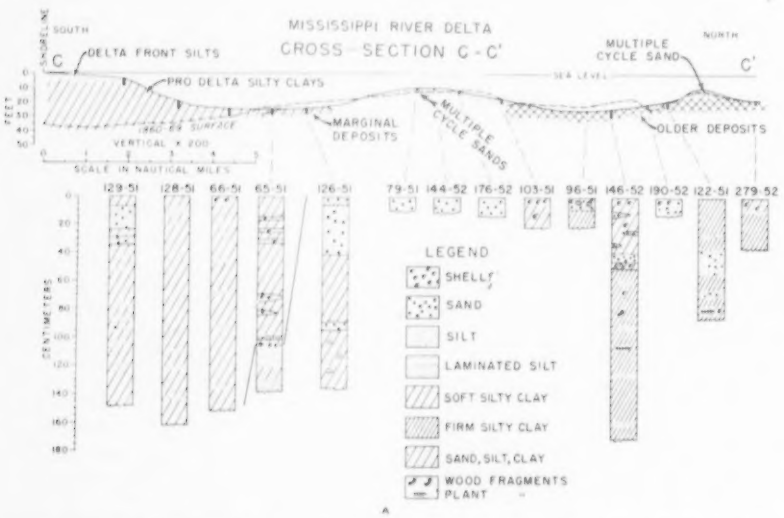


Fig. 5—The abundance of mollusks at various stations along the east side of the Mississippi Delta. Note sparsity of the fauna in and near the distributary mouths and in the sand area offshore. (Data supplied by R. H. Parker.)

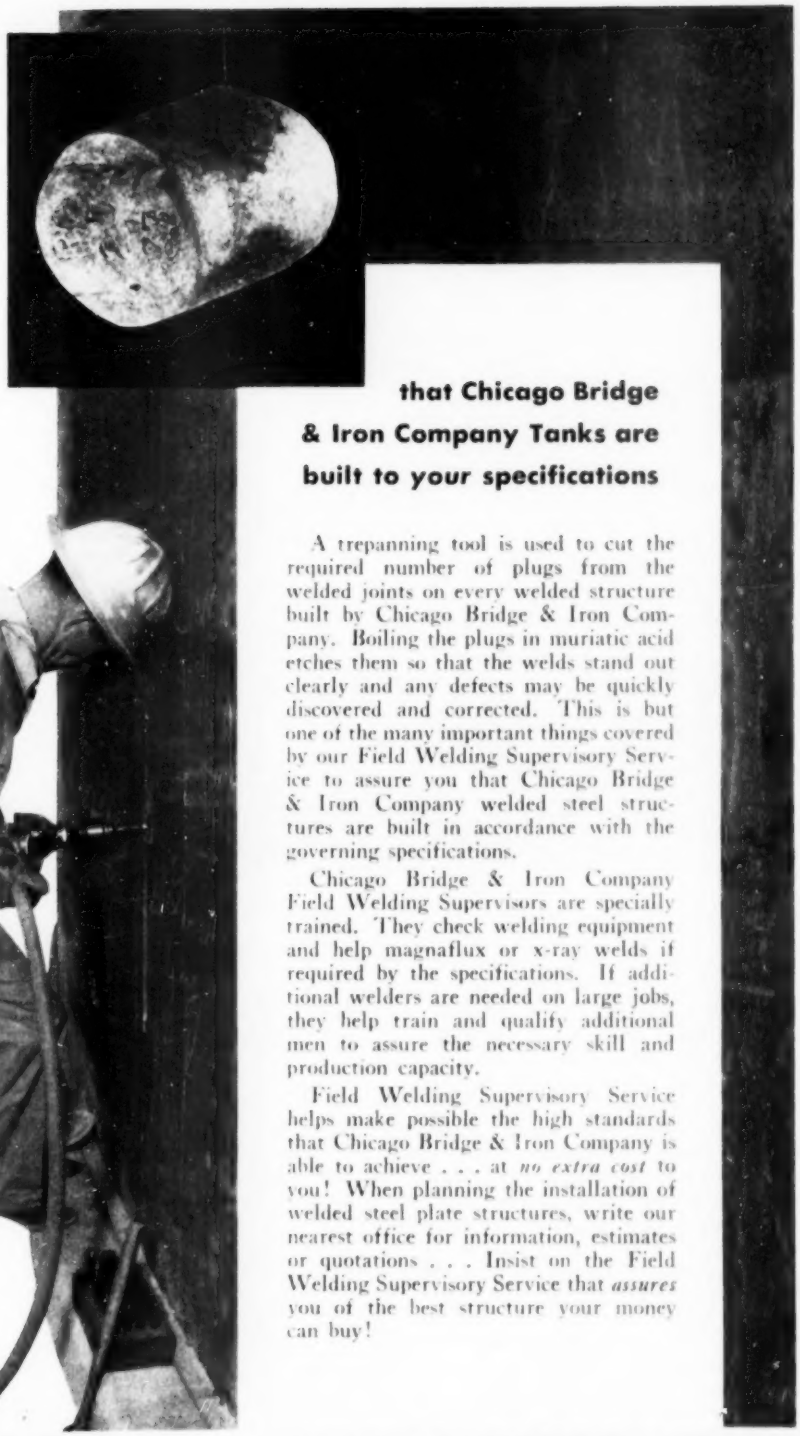
How to distinguish . . . The differences between these various environments of the Texas coast have been most strikingly indicated by the plots of estimates of the constituents of various sieved sizes of the sediments' coarse fractions.

The procedure is as follows: The material is first treated with hexametaphosphate (to disaggregate the fines) and wet-sieved to separate out the fine fraction. The coarse fraction is then sieved with a Rotop sieving device. Then the various sievings are examined under a binocular microscope, and estimates are made of the significant constituents. Most samples examined by this method have proved to be more related to their particular environment than to any other. Some of the environments can be distinguished by the



overlapping formations which are developing as delta front advances. (Data by P. C. Scruton.)

this little plug is positive proof . . .



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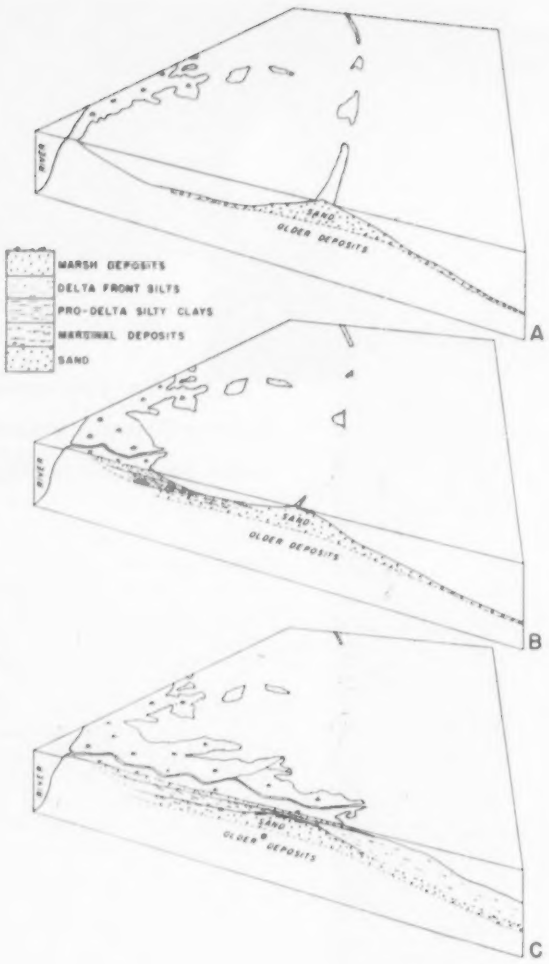

Fig. 6—Block diagrams showing the sequence of events in the truncating and overlapping of barrier-island sand bodies. These sand bodies formerly existed where Baptiste Collette subdelta has been built into the shallow sea. The destruction of the islands apparently is related to the flood of muddy sediment carried into the off-lying area by the rapidly advancing Main Pass to the south. This advance removed the chief source of sand for the feeding of the barrier islands, and it allowed the waves and currents to truncate them. This diagram is based on old surveys and on cores obtained in the area, and it is partly hypothetical. (Diagram constructed by Don Sayer.)

relationship of sand, silt, and clay.

The general assemblages of Foraminifera are quite distinctive in some of these Texas coast environments. This is illustrated by Fig. 2, in which pictures are included of a typical assemblage of Foraminifera from a bay near a river mouth, from an unmixed bay, from the swamps on the inner side of the barrier islands, and from the open shelf. Each of these environments is the equivalent, approximately, of one of the 14 environments developed through the microscopic studies of the coarse fraction. The macroorganisms, such as mollusks, corals, and echinoids, are influenced by the environments in somewhat the same ways as are the Foraminifera. The ostracods of low-salinity environments are quite distinct from those of high salinity. Pollen is wind-transported and, hence, is influenced by such factors as the distance from land and the abundance of pollen-producing plants on the land. Thus the sediments on the low flats inside the barrier islands appear to have the largest amounts of pollen in the Rockport area.

The clay minerals have been found by University of Illinois clay specialists to vary in their relationships according to whether they were deposited in fresh, brackish, or normal marine water. This is shown by a relationship between montmorillonite and illite and between montmorillonite and chlorite, with the higher ratios representing the lower salinities. Similarly, the chemists are finding that there may be variations in the chlorinity of the interstitial water in some sediments, depending on the salinity at the time of deposition. This can only be a relative difference, because postdepositional water migration in the sediments must change the original salinity. Also the carbon and nitrogen, at least, in Recent sediments vary according to environments. Spectrochemical analyses made for the project by California Research Corp. indicate that the

$$\frac{Al_2O_3}{K_2O} \text{ and } \frac{Al_2O_3}{Na_2O}$$

ratios decrease with distance from the Guadalupe delta.

Test of studies . . . The project has proceeded far enough so that tests can be applied at least to the Recent sediments of the Central Texas coast with a considerable certainty that their environments can be ascertained. As evidence,

A.P.I. Research Project 51

10 scattered samples from the Rockport area and adjacent portions of the Texas coast were examined, with locations temporarily withheld. Of these it was possible to pick the exact environment in nine cases by the coarse-fraction method alone, and the tenth environment was easily recognized by the Foraminifera. Various other tests were helpful in confirming most of these environments. Such a good record cannot be anticipated in all cases because some samples are gradational between two environments, and others no doubt have had some unusual influence which may make their appearance deceptive. Nevertheless, the record looks promising at the present time, and more opportunity to check the methods is being awaited.

The tests on Recent surface samples do not necessarily indicate that the methods can be applied to older formations now deeply buried; and, no doubt, some modifications to the criteria must be applied for older formations even where similar environments of deposition existed. To date, members of the project have tested certain samples obtained in test holes extending down to approximately 40 ft. along portions of the Texas coast. In these samples certain characteristics were found which indicate that the environments can be recognized quite readily, even after shallow burial has occurred. Deeper burial will no doubt cause modifications, and it will be more difficult to disaggregate the formations for examination of the coarse fractions of the sediment without the elimination of some of the important elements of these fractions. However, it seems likely that there will remain sufficient characteristics to determine the following environments:

1. Open-shelf deposits, with distinctions between those formed near shore and those on the outer shelf.
2. Sand and marsh portions of barrier islands.
3. Lower-bay deposits.
4. Upper-bay deposits near river mouths.

The importance of the oil industry's being able to distinguish between the muddy bay sediments and the muddy open-shelf sediments can be seen when it is recalled that between them lie the broad sandy barrier islands which constitute possible future oil traps.

Checks at depth . . . The project is currently conducting some coring operations extending to 40 or 50 ft. in the Rockport area in order to obtain more information on the third-dimensional aspects of present-day types of sedimentation.

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There are some indications that both the sands of the barrier islands and the muddy sediments of the bays do extend down to significant depths. The test holes made in the bays by the Army engineers indicate that the sediments alternate between coarse and fine material, but are of the same general type down to depths of at least 20 or 30 ft. Our examination of a few samples from borings on the barrier islands, obtained by the Army engineers and by petroleum companies, has indicated that the sands continue at least to depths of 30 to 40 ft. without much indication of change from present-day conditions. The sand ridges on the outside of the barrier islands suggest some seaward growth which may indicate that the sand masses are somewhat displaced in depth. This displacement is shown in the speculative subsurface interpretation in Fig. 1.

Other evidence shows that some barrier islands are being moved landward under the wave attack of storm conditions which may be more important than the accretion which takes place during small-wave conditions. In any case, if subsidence is faster than upgrowth, there is an opportunity for a thick barrier-island sand to become buried by fine-grained sediments and to be preserved as a lenticular or "shoestring" sand body. The greater compaction of the muddy sediments on either side may be expected to produce dips away from the sands.

Encroaching Mississippi Delta Environment

Through the efforts of R. J. Russell, H. N. Fisk, and others, much information has become available concerning the Mississippi Delta. From the point of view of marine sedimentation, the Recent sediments now being formed peripheral to the delta remained to be investigated. Following the suggestions of the steering committee, the project embarged on an intensive study of the area bordering the east side of the bird-foot delta of the Mississippi (Fig. 3), where rapid advances of the land margin are taking place under essentially natural conditions.

In this work very little attention has been paid to the better-known distributaries, South Pass and Southwest Pass, because these have been modified by man for about 100 years. The area bordering Pass a Loutre, Main Pass, and Baptiste Collete subdelta is especially important to stratigraphy because it represents an environment where sediments are accumulating in an open sea at a very rapid rate, in contrast to the Texas area. Very different diagenetic changes may occur because of the rapid burial of these sediments. This area is important also because a source of sand sediment derived from the sea floor, and to some extent from the sand islands to the northeast, is competing with the far greater source of sediment coming from the river mouths. In some places the sediment appears to be a combination of these two sources.

Old and recent surveys . . . Records of the Mississippi Delta growth extend back to the seventeenth century, but the first moderately reliable charts were made in 1838. The U. S. Coast and Geodetic Survey has shown some interesting comparisons of the shore lines of that time with those of 1934. The work of the project, by utilization of recent air-photo compilations, has extended this comparison up to 1952-53. Also we have introduced the third dimension by compilation of maps showing changes in depth which have resulted both from the advance of the subaerial delta and from marine sedimentation beyond the delta margin. Almost the entire east side of the lower Mississippi Delta has been built between 1860 (a year of a better survey than that of 1838) and 1952. This map of the inshore region shows that the greatest vertical change is off Pass a Loutre where the depth is now more than 100 ft. shallower than it was less than a century ago. Actually the bulk of the large changes occurs in a few years directly off the mouth of the advancing distributaries. Fig. 4 shows, in vertical section, the amount of depth change between 1860 and 1952 and the character of the sediment. The sections indicate that, even 4 miles from land, more than 40 ft. of fill has been deposited since 1860.

Overlapping units . . . The 562 bottom samples, mostly cores, obtained during the three delta field seasons are developing a picture of an encroaching series of sediment types which advance seaward with the advance of the delta (shown in part in Fig. 6).

The muddy sediments of the marsh surfaces of the delta, which also include some fine sandy zones in the natural levees along the margins of the stream channels, are bordered and underlain by coarse silts with little sand and considerable wood. This silt generally extends down to depths of from 3 to 6 ft., whereas off the major distributaries sand mixed with clay and silt extends to depths of as much as 25 to 30 ft. Finer-grained sediments occur at shallower depths in some of the interlobes between the delta bulges. Sediments which consist of soft, somewhat laminated, olive-gray silt and clay, with only a small amount of sand and with relatively large quantities of wood, border the silts. These "pro-delta silty clays" are much more extensive than the silts, and they form a band varying from 1 to 8 miles wide and extend to depths of approximately 120 ft. Seaward of the pro-delta silty clays, off the larger distributaries, there is a zone of lighter olive-gray clay which contains a high percentage of Foraminifera and other marine organisms, which lacks lamination, and which is comparatively stiff in contrast to the more fluid sediments nearer the delta.

Outside the pro-delta silty clays, to the northeast, the sediment consists either of clean, well-sorted sands called "multicycle sands" or of a mixture between the sands and the sediments of the pro-delta silty clays. To the north, in Breton Sound, there are heterogeneous deposits of buff to dark gray, poorly sorted mixtures of sand, silt, and clay. In contrast to the deposits directly off the active delta to the south, shells are quite common in this area, and these often are concentrated in bands.

Some of the cores penetrate through the upper layers of the encroaching pro-delta formations and reveal the presence of an outer band of delta sediment, now covered as a result of delta growth.

The delta sediment zones are of special importance because they indicate that it may be possible to find the direction of the shore line around the ancient delta deposits from the nature of the sediment. Among those features which are indicative of the nearness of a delta and the fast rate of sedimentation can be included:

1. High clay content throughout a relatively thick homogeneous section, which is unusual on the shelf.
2. Presence of laminations and undisturbed bedding, which also is rare in other marine sediments.
3. Abundance of wood fragments.
4. General absence of glauconite except a considerable distance from the distributaries.

Some of these same characteristics have been found on the shelf off Brazos River of Texas and off Sabine Pass. There seems to be little difficulty in distinguishing the sediments in Breton Sound from those in the open gulf to the south. The faunas of the sediments in the sound are very different from those in the open gulf, and the sediments have considerably less wood because of greater distance from the distributaries of the Mississippi. Some spectrochemical analyses of samples in and around the delta indicate that differences may exist between different localities. Environment relationships can also be seen on a map which shows the total abundance of living mollusks in the Mississippi Delta area (Fig. 5).

Changes in sand bodies . . . The changes in the barrier islands northeast of the bird-foot delta provide interesting information concerning these sand bodies. The northern Chandeleurs have retreated westward about ¼ mile in the past century. On the other hand, Gosier Island to the south has had a very significant growth in recent years. The source of sand for this growth must have come from the relatively deep shelf and from the northern Chande-

(Continued on page 324)

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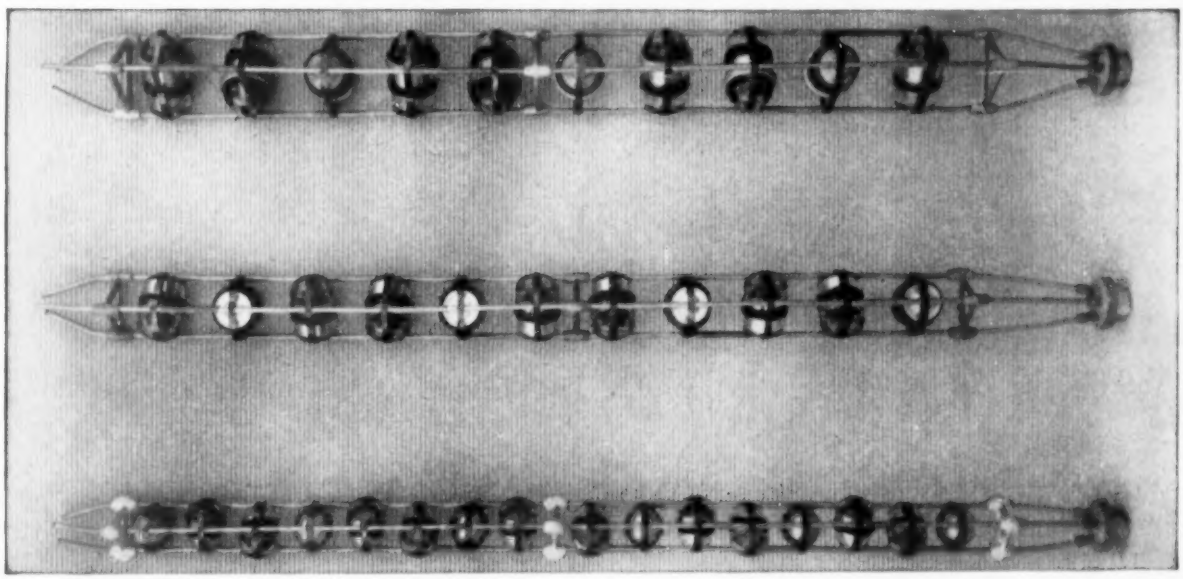

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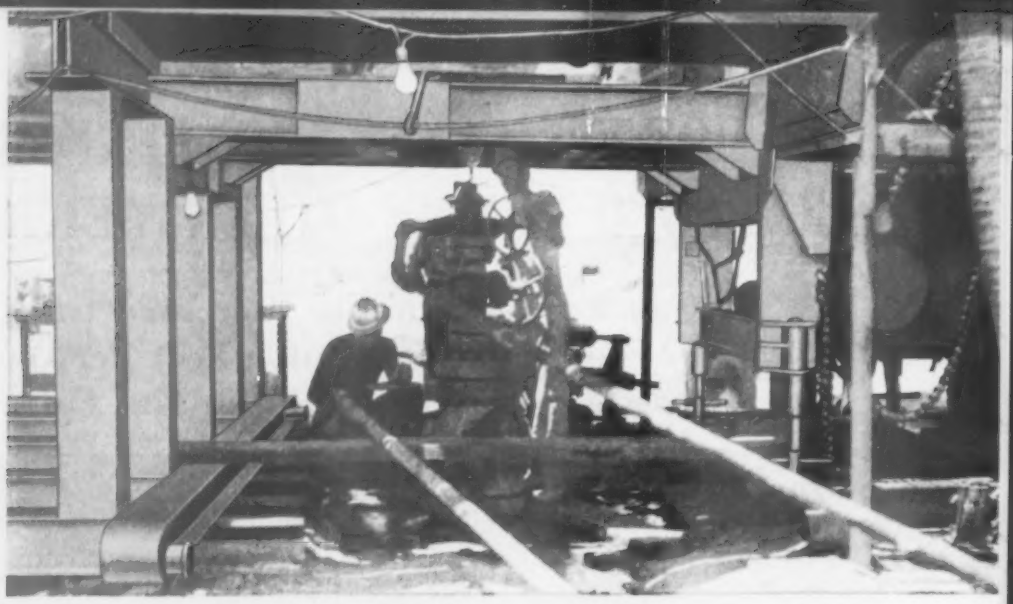

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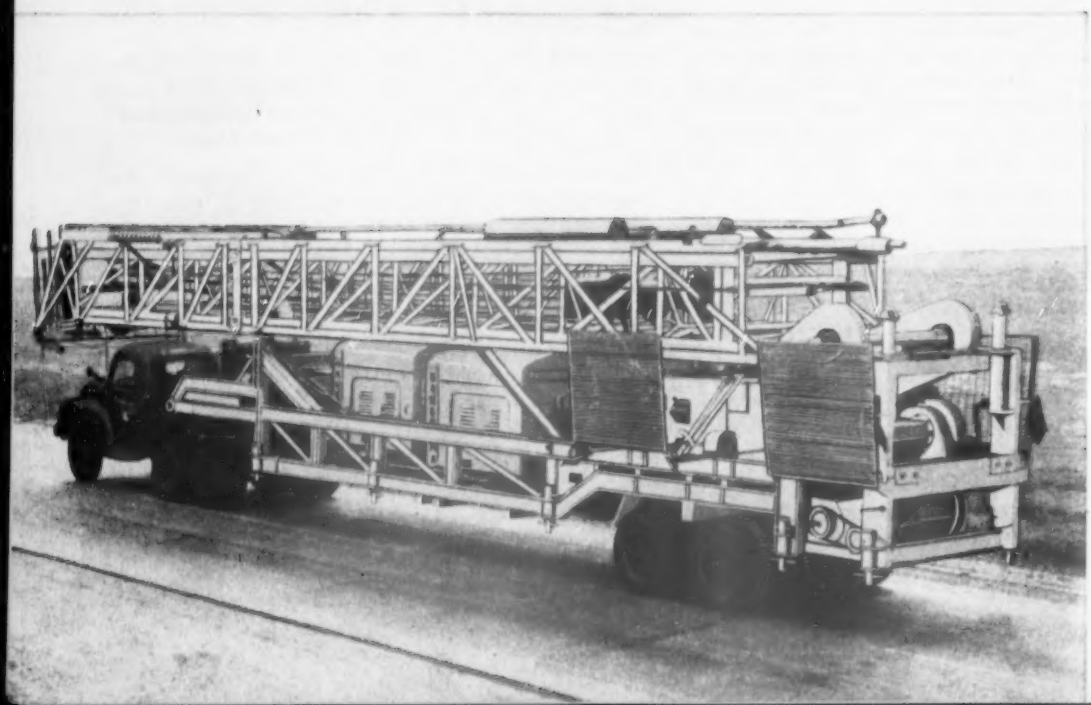

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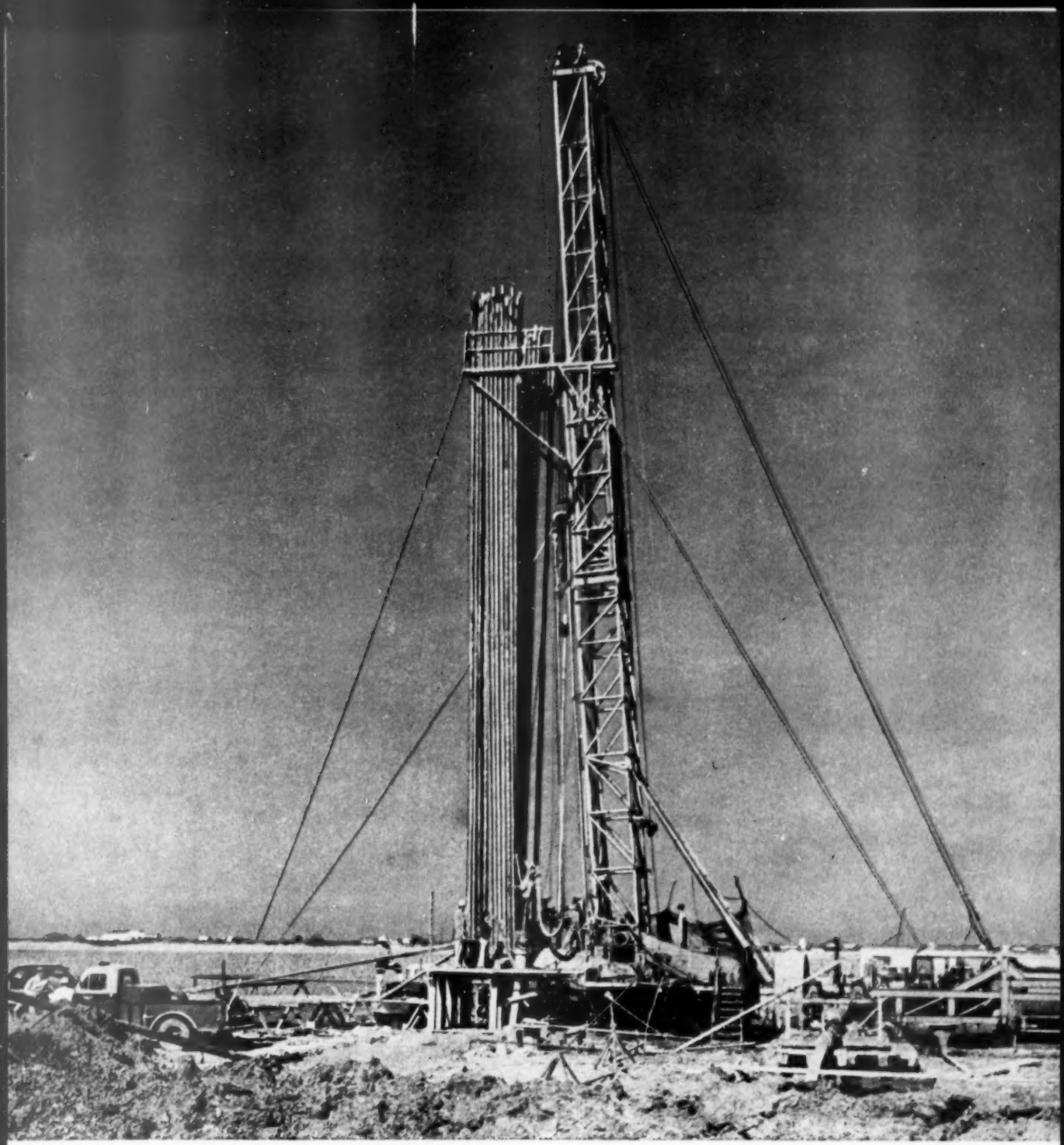

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A.P.I. RESEARCH PROJECT 47

Mechanism of Displacement of Oil

from porous materials

by M. Muskat,* A. Chatenever,† and N. Hackerman‡

IF one were to assume that research directed toward oil recovery would lead to economically feasible procedures or methods to double the currently expected yield from the oil fields already discovered and now being produced in the United States—an admittedly optimistic though not a physically impossible achievement—the increase in our established reserves of crude oil would be some 28 billion barrels. At a finding cost of $1.00 per barrel, such increase recovery effectiveness would provide an oil supply which otherwise would require an expenditure of 28 billion dollars were that to be done by current exploratory effort.

Microscopic Flow Structures

In order to see the various aspects of the microbehavior of reservoir-type systems, it is best to start with a solid matrix of homogeneous material and of regular and uniform geometry, and to consider the mechanisms which attend the flow of two immiscible liquids. Within this system a number of flow structures have been observed visually. These structures have been found to be characteristic of certain processes and of certain properties of the fluids and solid matrix.

Steady-State Simultaneous Multiphase Flow

For systems involving the simultaneous flow of two liquids, **channel flow** was found to be the prevailing flow mechanism. A diagrammatic representation is given in Fig. 1. Each liquid flows through the bed in its own continuous and separate network of channels. The channels have cross-sections on the order of magnitude of grain diameters, and are bounded by the liquid-liquid interfaces as well as the solid grain surfaces.

*Chairman, A.P.I. Research Propect 47 Advisory Committee, and associated with Gulf Oil Co., Pittsburgh; †acting director, A.P.I. Research Project 47b, and associated with the University of Oklahoma, Norman; ‡director, A.P.I. Research Project 47d, and associated with University of Texas, Austin. Paper presented at annual A.P.I. meeting, Chicago, November 9.

For steady-state conditions of flow, the channels are fixed in position and geometry. With a change in fluid saturation, there is a readjustment in the flow structure. An increase in water saturation is accompanied by a swelling of the water channels and a simultaneous reduction in the size of the oil channels.

If, however, the oil saturation is increased, the oil channels expand and the water channels contract. At a new steady-state condition, the flow structure is again stabilized in another form to accommodate the flow in its new proportions.

Under some extreme conditions of high flow or low capillary pressure, it was found that some flow takes place in the form of **slug flow.** Here part of the flow takes place in the form of slugs which involve a considerable amount of activity and energy change at the liquid-liquid interfaces. Usually the nonwetting phase was found to be the dispersed phase.

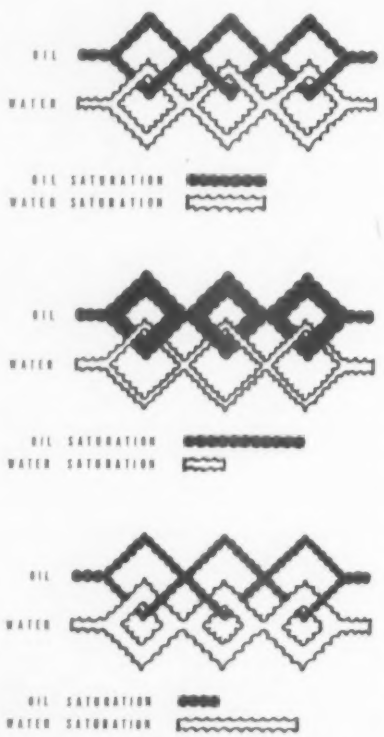

Fig. 1—Diagrammatic representation of channel flow.

Displacement Processes

In displacement processes in essentially regular and uniform flow beds, four characteristic microscopic flow structures have been found so far. These characteristics are associated in a casual relationship with the phases involved, the ratio of the viscosities of the fluids, the wettability of the system, and the saturation history. Where a liquid such as water or low-viscosity oil displaces a gas, soluble or otherwise, the process is characterized by a **single-finger** formation. Here the displacing fluid enters the bed as a single structure. With continued flooding, it grows mainly in the direction of flow and, to a smaller extent, perpendicularly. Fig. 2 presents a series of photographs showing progressive stages in a flood of air by water.

The liquid structure is surrounded by a water-air interface which takes microscopic twists and turns at the grain boundaries, depending upon surface tension and contact angles and the pressure differences between the phases. The pressure differences are dependent, at least in part, on the rate of flow and the viscosities of the fluids. The various factors involved operate in such a manner as to result, in this case, in an almost perfect displacement within the boundaries of the finger.

Where a nonwetting oil displaces water of similar viscosity from a 100 per cent saturated bed, the saturation distributions are characterized by **multiple-finger** formations. Here the fingers are somewhat smaller than those described above, but both formations are similar in the way they grow. The multiple-finger formations follow a progression wherein the first finger reaches essentially full development before it gives rise to a second finger via some few branching channels. The second finger likewise develops and gives rise to a third. This finger formation continues until there is no longer any room for additional fingers. A series of photo-

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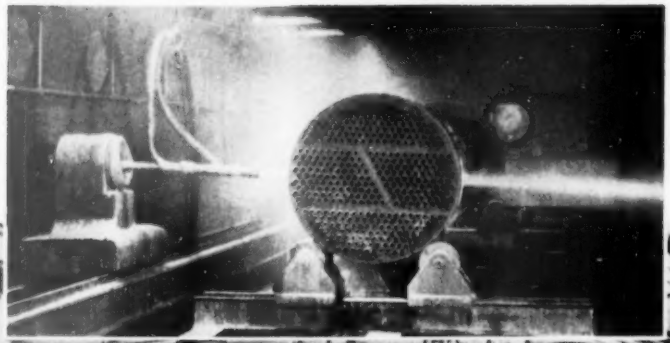

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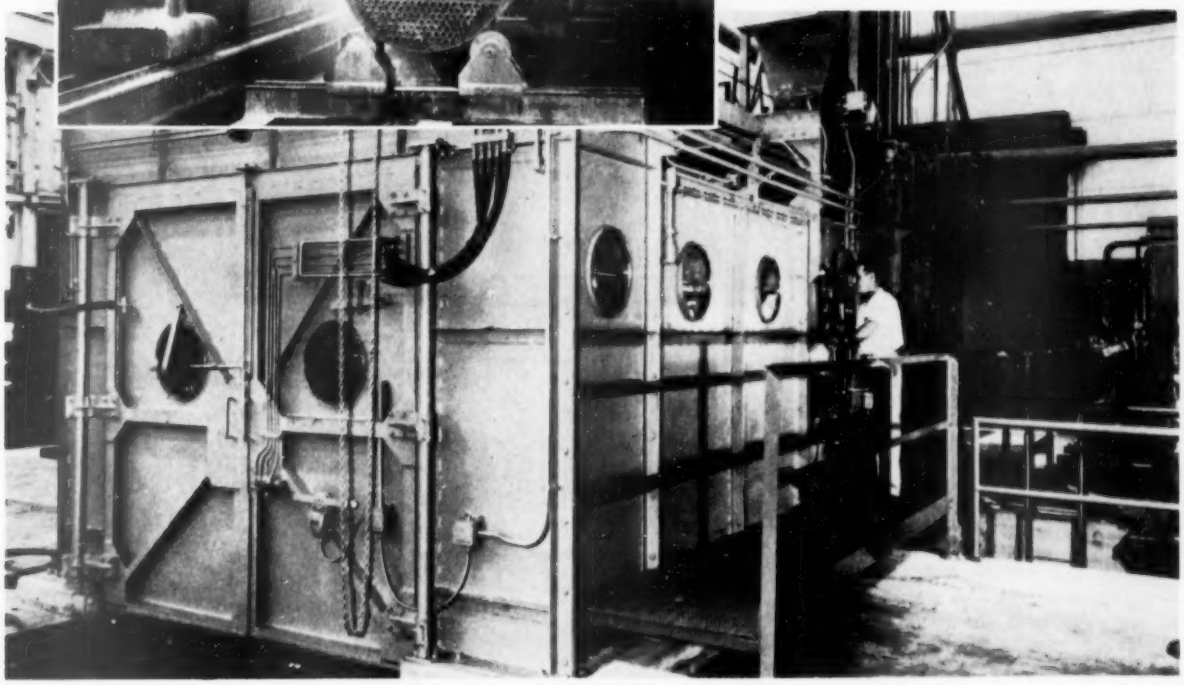

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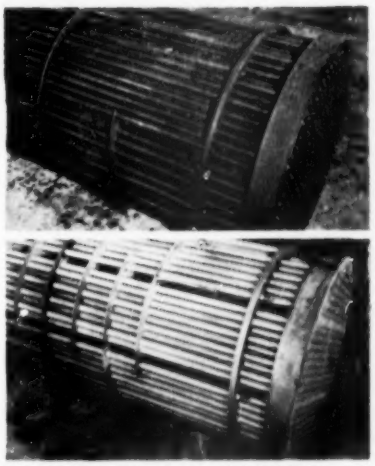

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graphs depicting a flood of this sort is given in Fig. 3.

Here, as in the case of the single-finger formation, surface and viscous forces are operative in determining the microsaturation structures. In the multiple-finger formation, however, the resultant effect is not a complete displacement within the finger. Instead there are microstructures where water had been bypassed so that it was left behind in numerous microformations within the finger. Thus a picture is provided which explains why a flood of this sort might not be so efficient as the single-finger formation.

In the case of a completely nonwetting-oil-saturated bed where the oil is displaced with water of similar viscosity, a **dendritic** formation is the structure established. The dendritic formation is developed by long slender fingers of the invading fluid which branch extensively so as to permeate the field and to trap the nonwetting oil in discontinuous insular formations. The displacing water moves radially from a point of entry in its areal coverage of the bed. A diagrammatic representation of the progression of this type of flood is given in Fig. 4. In a homogeneous bed this is a fairly efficient process.

Here, again, surface and viscous forces make their contribution to the net result. It is felt that most significant in making this process so different from the multiple-finger one is the change in roles whereby the wetting water phase becomes the displacing liquid and the nonwetting oil becomes the displaced phase. This picture suggests that, although the displacement of the oil might be fairly efficient, it is not complete. The cause for inefficient water displacements must be looked for in parameters not yet explored in these particular experiments.

Another situation is presented when water floods a field already saturated with water and oil—as, for example, one of the later stages shown in Fig. 3. Here the displacing water takes advantage of the water structures already present rather than establishing new saturation formations. Where there are present initially broad channels which provide easy passage, most of the flooding water flows through these, thus bypassing the oil structures and resulting in inefficient floods. Where the initial saturations are more finely divided into small structures and are more evenly distributed, the flooding water must so enlarge the narrow channels that they can accommodate the flow of the injected fluid. The water-channel en-

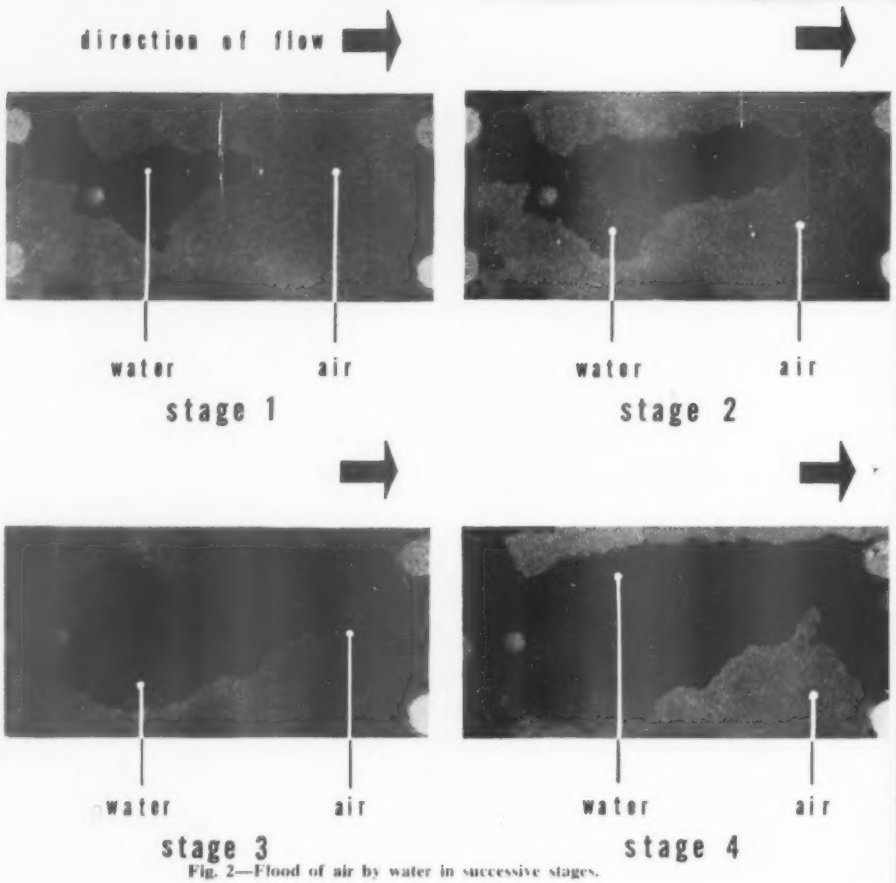


Fig. 2—Flood of air by water in successive stages.

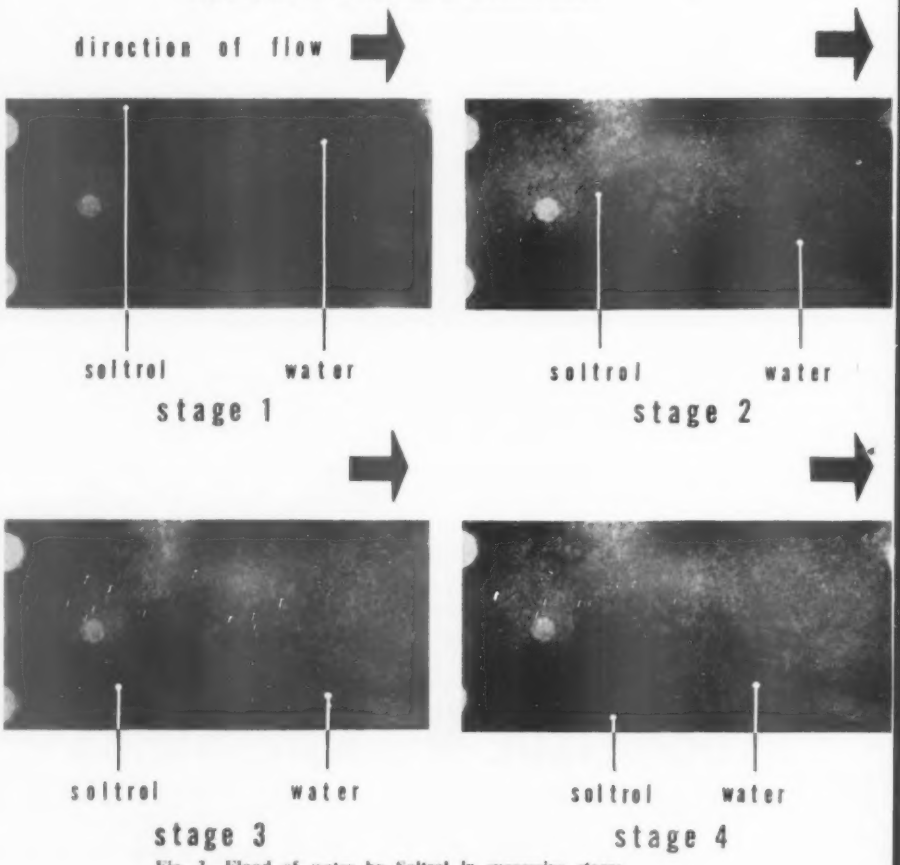
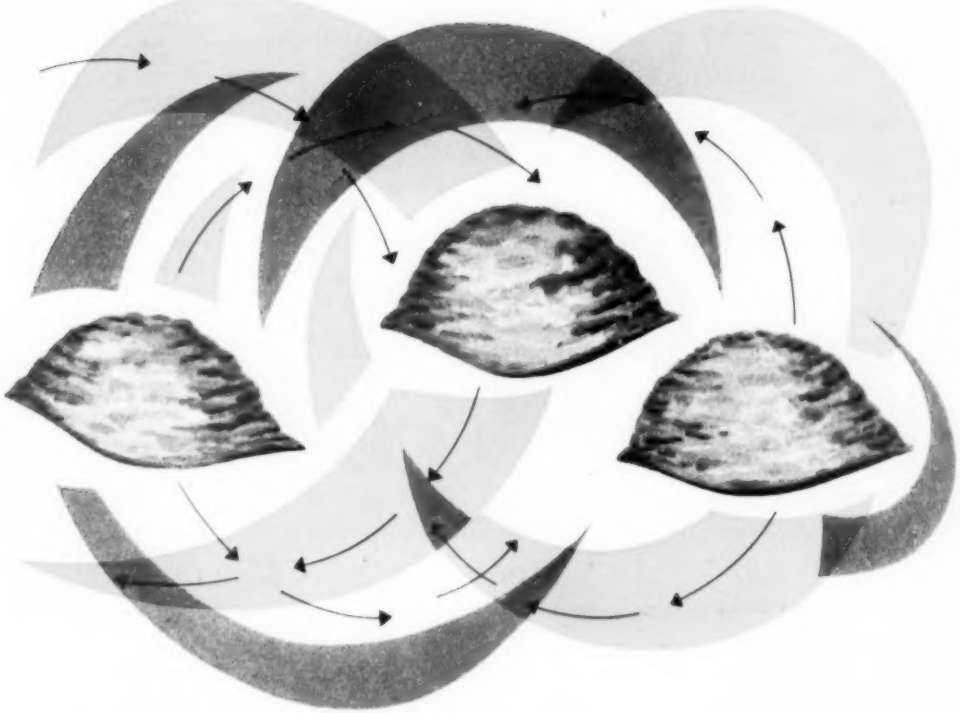


Fig. 3—Flood of water by Soltrol in successive stages.



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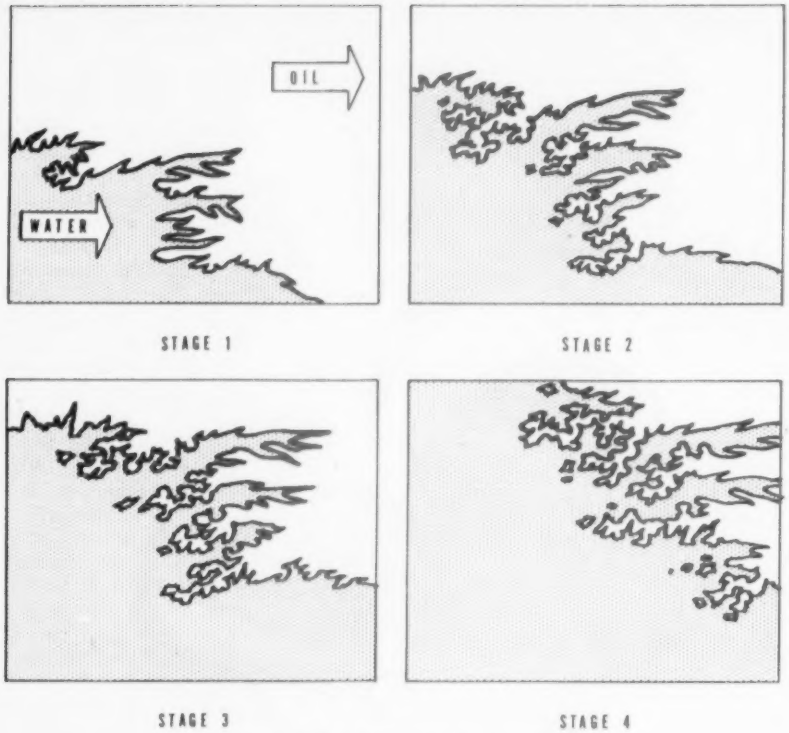

Fig. 4—Flood of Soltrol by water in successive stages.

largement takes place simultaneously with the reduction of the oil structures. Thus the oil is displaced toward the effluent end of the bed, and a more efficient recovery results.

As in all previously described cases, the saturation structures are confined within surfaces which are determined by the operative surface forces. Again the viscous forces contribute to the establishment of pressures throughout the liquid system which interact with the surface forces. The combination of these factors results in different modes of behavior for the flow of the fluids determining the efficiencies of the displacements.

Significance of Microscopic Flow Structures

Those flow structures which have been observed were seen only in experimental laboratory systems. They are obviously, and of necessity, simplified when compared to natural reservoir systems. What significance, then, do these have as natural reservoir phenomena?

The various experimental systems have a sufficient number of characteristics in common with natural systems to be called reservoir-type systems and to be expected to show reservoir-type behavior. Consequently, they can be used to explore the basic microscopic behavior patterns upon which so many of our ideas are predicated. This becomes particularly significant when it is realized that, because of the complexity of reservoir processes, it has been impossible to arrive at even hypothetical behavior with any degree of reliability.

Strangely enough, in the realm of hypothesis, we have been able to find too many, rather than too few, possibilities; and, inasmuch as all of them were both significantly different and equally plausible, more hypothesis was almost useless. By these explorations, then, it is possible to arrive at the resultant phenomena which arise from the numerous complex operative processes, and to present visual evidence of a few basic behavior patterns upon which to focus attention.

With channel flow, i.e., the prevailing regime for simultaneous flow, a number of significant factors become apparent. Both the wetting and nonwetting phases are continuous. Consequently, for steady-state conditions, flow takes place without any changes in the interface, and presumably this flow condition underlies the applicability of the Darcy equation to multiphase flow. Inasmuch as the channels involve a large number of liquid-liquid interfaces in addition to the liquid-solid surfaces, it can be seen how multiphase flow can be more tortuous than the flow of a homogeneous fluid. This provides an explanation for the low relative permeabilities characteristic of reservoir systems.

Because of the irregular shapes of rock pores, liquid-liquid interfaces move through these pores discontinuously with the application of pressure, and might even establish equal capillary pressures at different points along the length of a pore. Inasmuch as such interfaces bound flow channels and thus contribute to the determination of the saturation attending certain flow conditions, a microscopic picture is provided to help explain the hysteresis which relative permeability shows with saturation changes.

During steady-state flow the sum of the operative surface forces may be considered constant. Then the flow may be analyzed without any consideration of phenomena such as the making and breaking of liquid-liquid interfaces. However, a change in saturation necessarily involves work to overcome interfacial pressures. Indeed, it is considered that these forces are definitely effective in the formation of the microsaturation in structures during displacements.

For some time it has been realized that viscous and surface forces played critical roles in reservoir displacement processes. This realization has been of a truly general nature, ignoring for the most part any consideration of mechanism. This project has been able to provide detailed descriptions of microscopic processes, making apparent some of the ways in which these forces work. Thus, for floods of gases by liquids, the resultant effect is an essentially complete displacement; whereas in two-liquid systems there is always some residual in the form of microstructures.

The presence or absence of microresidual structures follows from the way the microfingers work their way through the matrix pores to trap the material to be produced in a pincer-like action or to displace it completely before an unbroken front in response to applied pressures, viscous resistances, the spontaneous pressures generated by the liquid-liquid interfaces, and the geometric arrangements of the pores.

It is now feasible to examine the ways that the general phenomena of fluid flow operate in the microscopic details of reservoir-type behavior. The microsaturation structures are obviously outlined by interfaces. These are shaped by interfacial tensions and contact angles. It is apparent that the shapes of these surfaces are irregular and complex, and that the pressures

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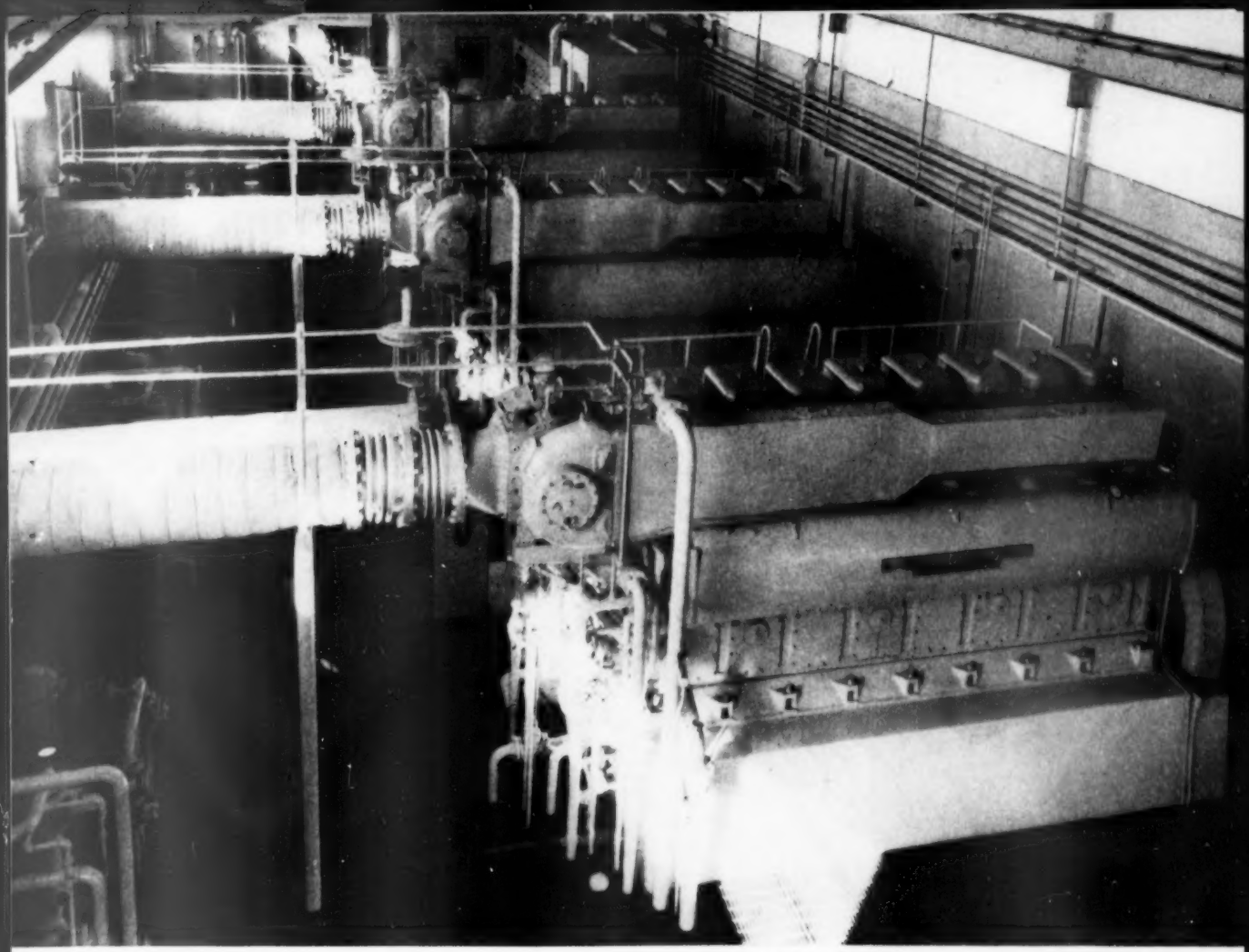

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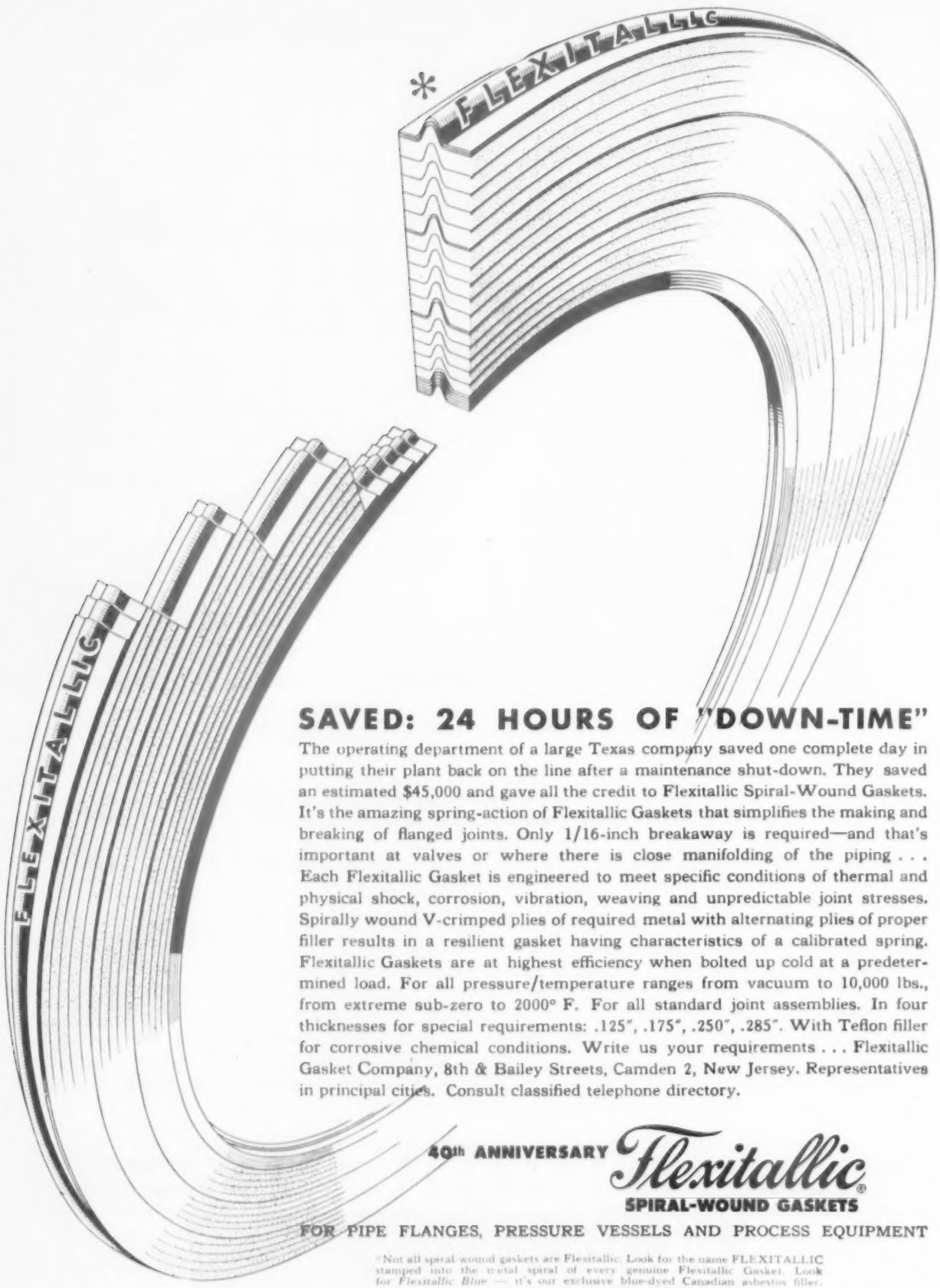

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by John V. Pennington

SIGNIFICANT improvement in drilling rates can be brought about only by making more power available at the bottom of the hole and by using it percussively, at least in part. The development of percussive equipment depending upon increasing the supply of hydraulic energy is in the capable hands of a number of companies, and is going ahead with marked success, particularly in several special applications.

There remains the possibility of transmitting down hole high levels of electric power (of the order of 200 hp.) which might be used to actuate either rotary or percussive devices, driven by motors, magnetostrictive or piezoelectric transducers, variable-reluctance or tractive magnet mechanisms, etc.

A transmission line consisting of drill pipe with integral electric conductors has been developed, and one type of transducer was selected for development that is capable of delivering up to say 1,000 percussive blows per second, a range far exceeding the possibilities of mechanical or hydraulic devices. That any economic advantage exists with frequencies above 300 blows per second (18,000 per minute) is, however, very doubtful.

Author is associated with Drilling Research, Inc., Houston. Paper presented at session on production, annual A.P.I. meeting, Chicago, November 11.

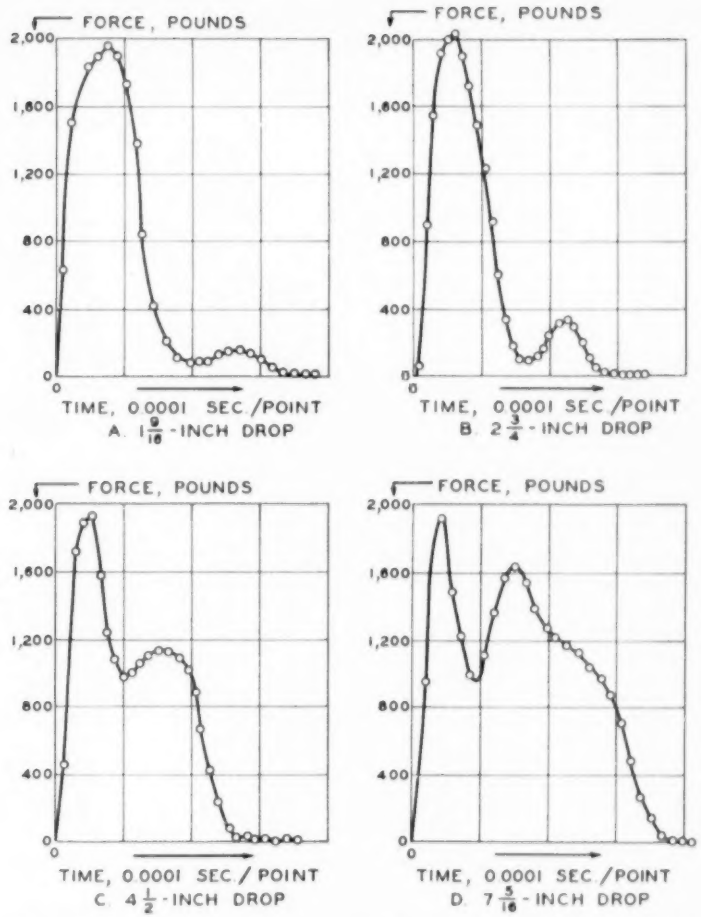

Fig. 1—Tracings of typical force waveforms for various heights of drop with the 0.03-in. bit and weight of 15 lb. for single blows on Indiana limestone.

Drop Tests

An instrument called a drop tester was devised with appropriate instrumentation for quantitative observation of the same phenomena, and this was used for the first series of tests. The drop tester consists of a rod carrying a cylindrical mass at the upper end and a bit at the lower end, the assembly being constrained for essentially frictionless vertical fall. Strain gages are applied close to the bit so that the force waveform can be recorded by an oscilloscope camera.

Another camera provides high-speed motion pictures at the rate of about 3,000 frames per second. The weight of the mass and the height of fall being known, the energy of impact, velocity, and momentum are easily calculated. The forces throughout the cycle are given by the force waveform obtained with the oscilloscope camera, and the motion pictures provide displacement-time and velocity-time curves as well as specific information as to the time and place of chip formation.

The drop tester can be indexed across the face of the rock to provide for successive impacts at predetermined distances from each other. The volume of rock removed by each blow can be determined by direct measurement or by filling the hole with Plasticine, which is easily removed and weighed.

This simple apparatus provides for an almost interminable number of interesting experiments, in which the controlled parameters of mass, height of fall, and indexing can be varied over the pertinent range, and various rocks and bits can be investigated.

It was first necessary to be assured that the dimensions and construction of the apparatus did not produce spurious effects by virtue of internal phenomena. In particular, it was determined that the length of the rod separating the mass from the bit had no effect, up to 18 in. of length, on the force-time curve of impact. There is theoretical reason to believe that there might be such an effect resulting from

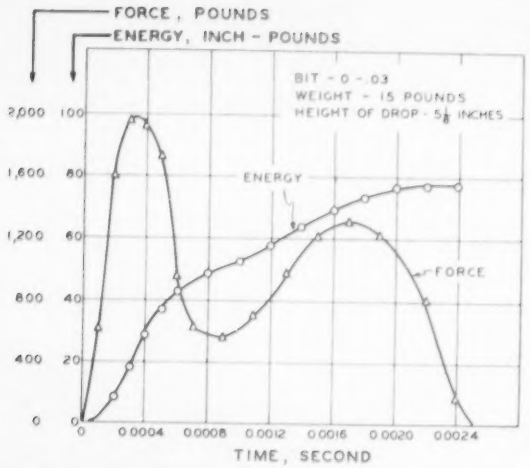

Fig. 2—Superimposed force-time and energy-time waveforms for a single blow in Indiana limestone.

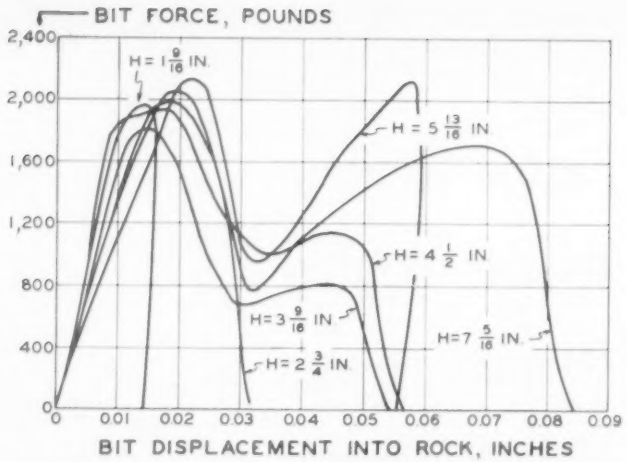

Fig. 3—Bit force as a function of displacement of the bit into the rock for several heights of drop of single blows with the 0.03-in. bit.

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the time required for a compression wave to travel up the rod and be reflected back to the bit. Because no substantial effect was observed, the falling assembly could be regarded as a lumped mass, making it then possible to use the force waveform as an acceleration-time curve for the bit edge.

Tests are confined, except where otherwise stated, to the cases in which the rock is a rather uniform Indiana limestone and the bit is a chisel edge, ¾-in. long, with a .03-in. wide flat end and parallel vertical flanks.

Force and Energy in Drilling Rate

Single blows were made using a 15-lb. weight at various heights of drop. Fig. 1 shows four of the resulting curves of force at the bit vs. time, each curve being typical of a large number of observations. The first peak occurs at a force of about 2,000 lb. regardless of the energy level of the drop. Then the force decreases and a second force peak results whose value increases with the energy level of the drop. For heights of drop below $\frac{9}{16}$ in., the second peak is missing and the first peak varies with energy level. Above 6 in. of drop height, the second peak may also become constant in magnitude but sufficient data are not available to establish this point definitely.

The volume of rock removed in a single impact varies linearly with the height of drop, and therefore with energy of drop, the straight-line graph intersecting the energy axis at a point which may be called the threshhold energy, below which substantially no chips are formed.

A significant finding arose from a series of observations directed to the question as to the effect on the amount of rock destruction of changing the velocity of impact or the momentum of the blow at a given energy level. The results showed, for the range of velocities and energies considered, that the amount of rock removed is dependent upon the energy alone. The velocity variation amounted to only 24 per cent; consequently, further tests will be needed to determine whether or not the preceding statement is broadly valid.

Energy dissipation . . . The dissipation of energy during an impact blow can be determined by integration of force wave forms, such as those shown in Fig. 1. Knowing the weight of the falling mass, the force scale can be replaced by an acceleration scale, as mentioned previously; and, by integration, the velocity can be found for all values of time. The energy dissipated up to a given time is then the time-integral of the product of velocity and force.

When this is carried to the time when the velocity is zero (i.e., the time of deepest penetration and just prior to rebound), the total energy should approximate the potential energy of the mass before its fall, and it does so very closely. The energy found by integration to the time when the force is zero is less, by the energy of rebound, than the total energy, as expected. Study of the way in which energy is dissipated over the entire impact cycle is of interest in determining the most effective means for its utilization in disintegrating the rock.

In Fig. 2, the energy consumed up to any given time is shown superimposed on the force waveform for the 5⅛-in. drop shown in Fig. 1. It is seen that approximately half the energy is consumed during the first force pulse for this height of drop. In general, all the energy is used in the first pulse up to a certain height of drop. Above this height, the energy so used is a constant, the excess energy going into the second pulse. The high-speed motion pictures, to the extent that they have been taken so far, show that the spectacular removal of large chips takes place during the first pulse.

However, the fact that the total amount of rock removed is linearly related to the energy of impact, and the fact that the energy dissipated in the first pulse assumes a constant value, suggests the simple hypothesis that the amount of rock removed per unit of energy for the first force peak may be the same as for the second, during which, generally speaking, smaller chips and power are formed. It must be remembered that these remarks apply to a certain type of chisel edge and a certain rock. Other combinations of bit and rock may show more effective use of energy in the first pulse than in the second. More data are needed on this point. However, the approach to the problem is thought to be clearly exhibited by the foregoing analysis.

Force-displacement curves . . . Curves of displacement vs. time can be obtained in two ways, from integration of the velocity waveforms and from the motion pictures. The two are in close agreement. These curves lead to nothing of particular interest in themselves, but provide a basis for developing force vs. displacement curves.

Fig. 3 shows force-displacement curves for several different heights of drop. It has long been desirable to obtain such experimental curves for impact blows, but apparently this work represents the first successful effort in that direction. The story of an impact blow is significantly portrayed on these curves. The general trend of the force-

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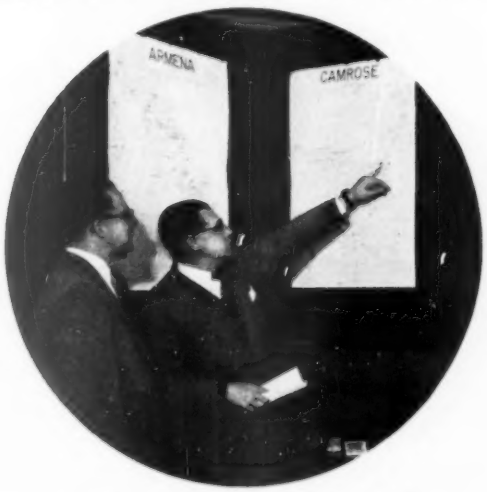
F. J. C. Caine, Manager, Edmonton Branch (right), during a visit to a well-head "Christmas Tree".



Mr. Mayne (right) confers with A. D. Insley, Manager, Oil & Gas Department

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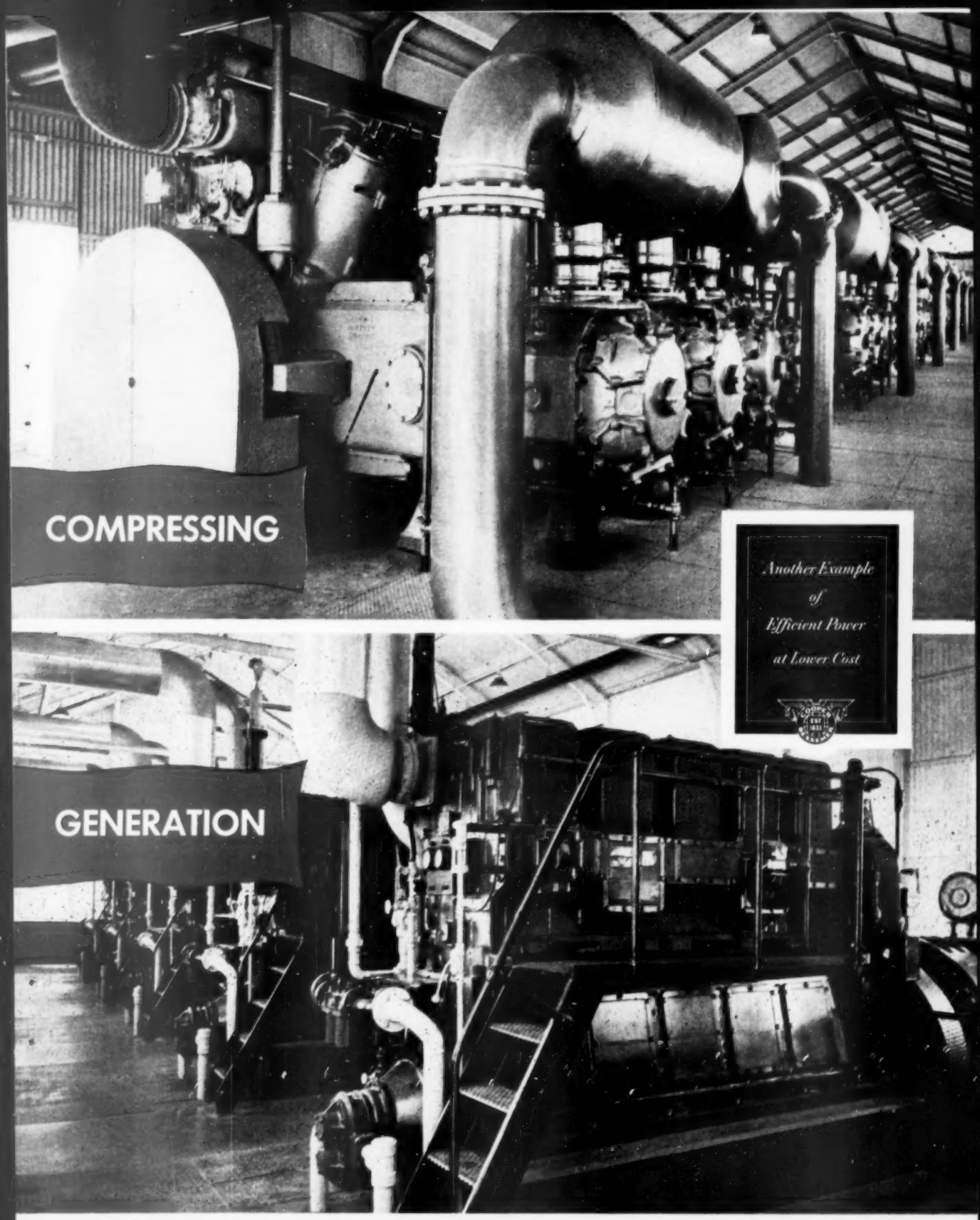

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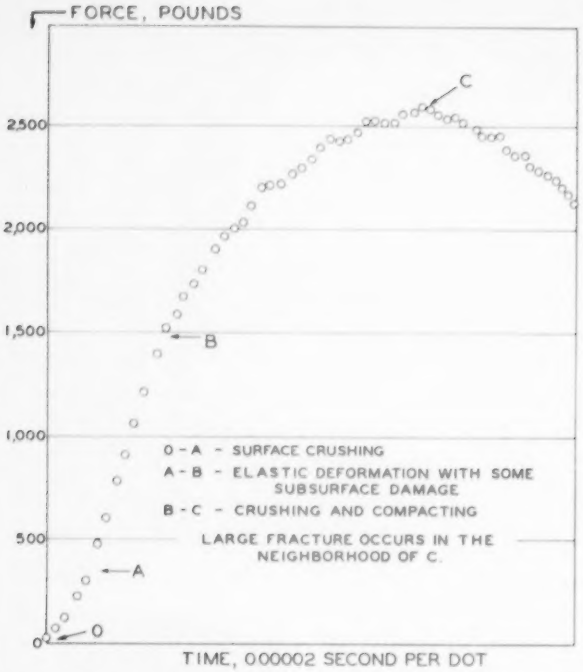

Fig. 4—Expanded first force pulse of a force waveform for a single blow with the 0.03-in. bit on Indiana limestone.

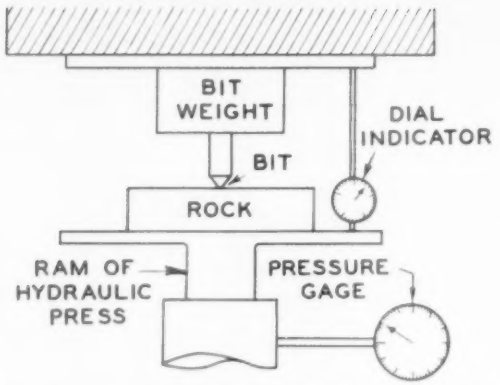

Fig. 5—Schematic diagram of static loading tester, bit-rock pressure supplied by a Carver hydraulic press.

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displacement curve is the same as that of the force-time curve, but the former, as shown in Fig. 3, displays a substantial coincidence during the first pulse for all energies above the threshhold level.

Thus, for all such energies, the impact produces the same force variation over the same depth of penetration for the first pulse, during which the larger chips are ejected. It is as though the falling chisel broke through a shell of given thickness and then, depending on the height of fall, resumed its penetration into a lower layer to a depth depending on the remaining energy.

The initial pulse of one of the force-time curves is shown in Fig. 4, with an expanded time scale. On close examination it is seen that it consists of four distinct regions. The region O-A has a slowly rising slope and corresponds to fracture and crushing of small irregularities on the surface of the rock. The force of the bit is thereafter transmitted through a thin layer of powdered rock. The region A-B has a constant, high slope corresponding to elastic deformation of the rock, together with some subsurface damage. If the energy of impact is insufficient to raise the force of the blow above B, a considerable fraction of the energy returns in rebound or bounce of the bit, leaving merely a surface mark as visible evidence of the blow.

At point B the crushing strength of the rock has been reached. In the region B-C, a narrow portion of the rock is crushed and compacted, forming a wedge of compacted material directly under the flat of the bit. Through this wedge the increasing force is transmitted to the rock on each side, where elastic energy is being stored and strain trajectories are being developed. When the force reaches its peak at C the rupture strength of the surrounding rock has been reached and chips are formed by failure along the curved, almost horizontal trajectories of principal shear.

As the chips break out, the central wedge, having lost its support, crumbles. As a result, in the region beyond C the force rapidly drops in value until the bit again contacts solid rock. The amount of chip-removing circulation determines the extent to which the powdered wedge under the bit edge damps the continued progress of the bit, and the effectiveness of the second pulse.

The amount of rock chipped out in a single-impact blow is of interest in the drilling process, but so also is the amount of subsurface damage. The latter represents useful expenditure of energy that will pay dividends as succeeding blows are struck. One way of getting at least a qualitative view of the extent of such subsurface damage caused by a single blow, is to strike the blow in question near the edge of a block of rock but not close enough to break the edge off.

A second blow, heavy enough to knock the edge off the rock, is then struck right alongside of the first at the same distance in from the edge of the rock. Referring now to the first blow, which is the one under examination, if the height of fall was less than ½ in., the line of fracture caused by the heavy blow never followed the line of the first impact blow. For heights of drop from ½ to ¾ in., the fracture always followed this line showing that some damage had been done. However, the fractured surface under the line of the first blow showed that no crushing had occurred, inasmuch as no powder was present.

The damage presumably consisted of cracks in the grain boundaries. For heights of drop above ¾ in. the fracture again followed the line of the first blow and crushing was evident under the flat of the bit edge. Often the crushed material could be removed from the new surface in the form of a compacted wedge which could be crumbled between the finger.

Other Bits and Rocks

The angle between the flanks of the chisel-edged bit has considerable effect on the drilling characteristics of the bit. In all of the foregoing work the flank angle was zero, i. e., the flanking faces were paralleled. In a series of tests employing flank angles of 45°, 90°, and 135° it was found that, for a given height of drop, the peak force developed at impact varied directly as the square root of the tangent of half the flank angle; and the amount of rock removed varied inversely as the tangent of half the flank angle.

In another series of tests the width of the flat bottom of the chisel edge was varied, with the expected results that the wider flats drilled more slowly. However, from the evidence obtained

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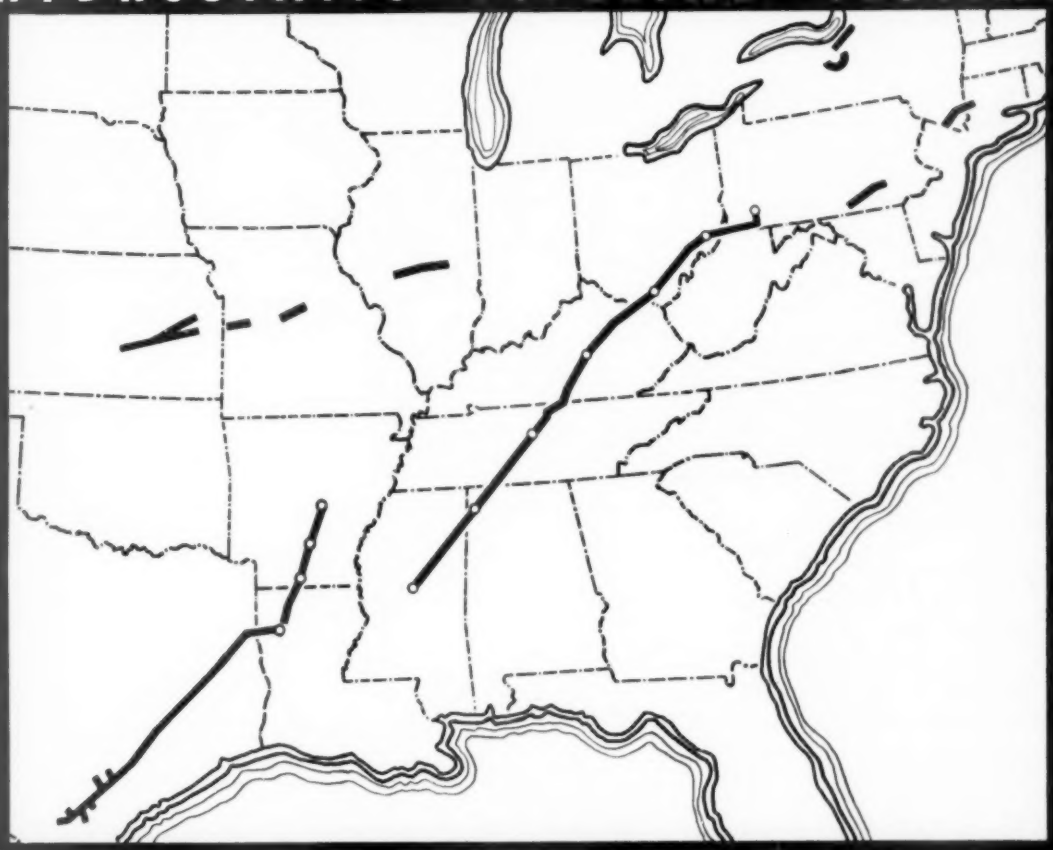

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thus far, it appears that small flank angles are much more important for the achievement of rapid drilling rates than the avoidance of flats, or dullness, on the bit edges, provided that the energy of the blow is above the threshhold value required for the initiation of rock fracture. Experience with the drop tester strongly suggests that the optimum bit edge for percussion drilling may be one with zero or a small flank angle, with just enough width for the strength required. Furthermore, the drilling characteristics of such a bit should not change perceptibly until the edge is completely worn down.

Tests were made on rocks other than Indiana limestone. So far, data are insufficient except for Columbus limestone, which shows phenomena very similar to those obtained with Indiana limestone, but with drilling rates approximately one-fourth those in the latter.

Repeated blows . . . Next in interest, after the single impact blow, is the effect of repeated blows on the same spot. This occurs in percussive drilling when a cone or roller bit is used, and also, in effect, with very small indexing angles when star bits are used.

When successive blows are struck by the drop tester on the same spot, the debris being blown out with air after each impact, the second blow removes considerably more rock than the first, and third still more. Thereafter, the amount removed decreases gradually until it is negligible to, say, the sixteenth blow. This indicates that the first blow has done some damage to the rock, not revealed by the amount of rock removed. Close inspection shows that some crushed rock was not removed by the air blast, although the blast was believed to be equivalent to good bottom-hole fluid circulation in its chip-removing efficiency.

Another phenomenon may also be present — progressive fracture, for which some evidence was presented previously. A few investigators have spoken of the fatigue of rock in percussive drilling, and the phenomena under consideration here may be so labeled if one chooses. Measurable failure occurs after several cycles of stress. However, a series of conventional fatigue tests on specimens of limestone and granite, both in compression and in torsion, failed to reveal, after thousands of cycles of stress, any endurance limit appreciably below the static strengths of the rocks. It is believed that failure will not occur at stresses below the rock strength and, therefore, that fatigue as generally understood is not present.

Indexed blows . . . It now becomes of interest to inquire as to the effect of spacing the impact blows from each other in a direction perpendicular to the bit edge by an amount called the "indexing distance." If the indexing distance is sufficiently great, each blow will, of course, have the same effect as a single blow. However, statistically speaking, there is a critical distance, dependent upon the energy of the blow, such that when the second, or indexed, blow is struck, it knocks out more or less flat chips extending back to the previous crater.

The amount of rock removed by a blow in this way can be of the order of three or four times the amount removed by a single blow with the same expenditure of energy. Indexing, therefore, appears to be of importance in the efficient use of the energy available for drilling, and gives significance to the ratio of frequency of percussion to rotation rate. Roughly speaking, greatest efficiency with a star bit would be attained when it is rotated in such a way as to strike successive blows spaced apart at the periphery of the hole by a distance equal to the critical indexing distance. With a cone or roller bit, the greatest efficiency should be obtained with a distance between teeth approximating the critical distance.

The foregoing work was corroborated in a series of tests in which the single chisel-edged bit was rotated after each impact blow by an amount referred to as the indexing angle. It was found for each rock that there was a critical indexing angle, at which the highest drilling rate was obtained, the rate falling off for lesser or greater indexing angles.

Static Loading Tests

Further information leading toward a working theory of percussion drilling was obtained in static loading tests. The same rock and bit were set up in a hydraulic press with provision for measurement of force and displacement, as shown in Fig. 5. The crater formed in the rock resembled closely those formed during the drop tests. The chips, however, remained in place instead of flying out as in the drop tests. The force-displacement curve was closely similar to that obtained in the drop tests, and the first major fracture occurred at the same force level. Again, therefore, it appears that the amount of rock removed is independent of the rate of application of the load.

In one respect the static loading tests gave results which were not in line with some of the drop-test results mentioned previously. In the static tests it appeared that the energy required to fracture out a given amount of rock was considerably less than for the drop tests. For the static tests the loading was usually increased in each test until major chipping occurred, whereupon the test was terminated. On the other hand, for the drop tests, a given fixed amount of energy, as determined by the potential energy of the weight, was introduced into the system for each test.

If this amount were more than enough to produce major chipping, the remainder would be essentially wasted unless it happened to be enough to produce a second major chipping action. If the energy were insufficient to produce the first major chipping, it would be largely wasted. In practice it would not be entirely wasted, because the rock may be left in a weakened condition so as to contribute to the effectiveness of subsequent blows. Thus, if a practical means could be devised for removing the lead each time as soon as chipping occurred, much more efficient drilling would result.

Drillability . . . All of the foregoing is illustrative of the way in which percussion drilling can be studied blow by blow with the variables under complete control and with the problem of instrumentation and measurement tremendously simplified. The technique can be applied to the investigation of fracture of all oil-country rocks—soft, hard, friable, and tough. It can be used to study variations of bit-tooth forms and of assemblages of teeth into a complete bit. The effect of the presence of water and other drilling fluids on the drillability of the rock can be determined. The motion of the falling weight can be constrained to simulate simple harmonic or other velocity cycles to measure the effect of the motional constraints of actual drilling tools, etc.

A measure of drillability is suggested by the close correspondence of the static to the impact tests. It is well known that the drillability of rocks by conventional tools cannot be correlated with any of the standard methods of measuring hardness, nor with the crushing strength, grinding rate, or other parameters used for ranking materials.

However, insofar as percussion drilling and possibly rock-bit drilling are concerned, it appears that drillability is a simple function of the peak force developed in the first force pulse and of the amount of crater produced when a chisel-edge is pressed into the face of the rock in question. More data are required before this can be formulated with any degree of confidence.

High-Frequency Percussion

Next in interest, after single and repeated impacts, comes the study of

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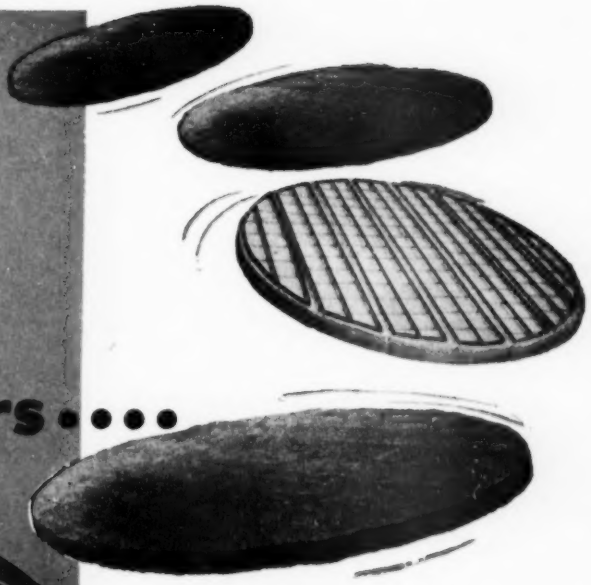

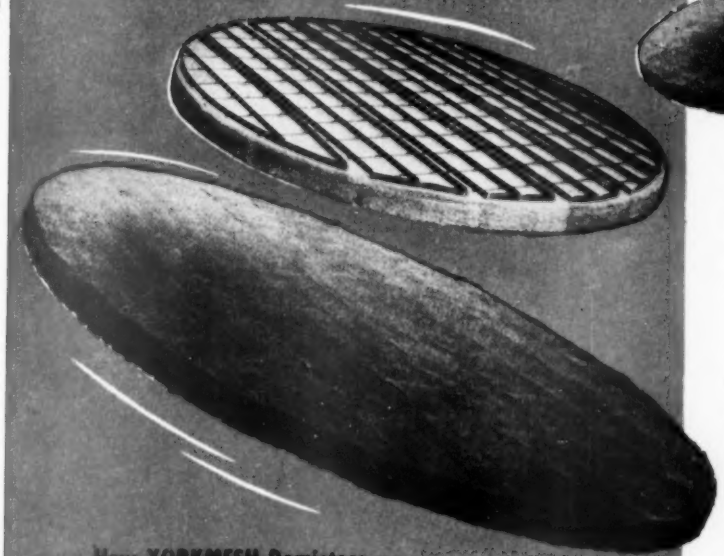

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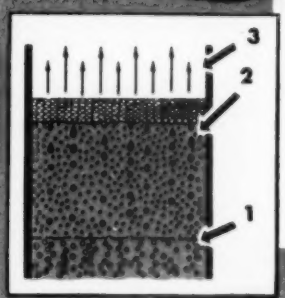

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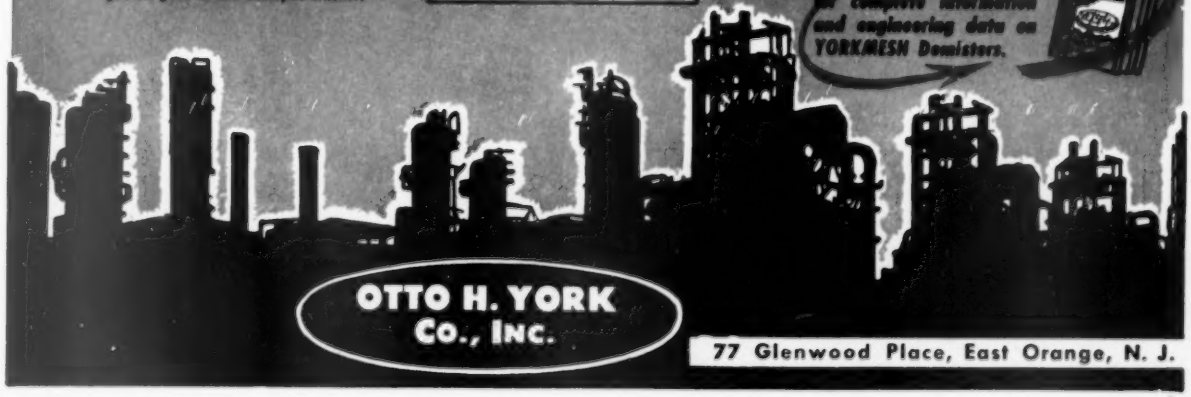

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rapid successions of blows as in the actual drilling process. The range of frequency studied was from 60 to 1,400 cycles per second; and, in almost all instances, the rock was Columbus limestone. This limestone is made up of a grayish matrix with Moh's hardness of 3, containing irregularly sized and shaped white inclusions of Moh's hardness exceeding 4, and is somewhat fossiliferous.

Three types of apparatus were used: (1) a pressure chamber, containing the rock specimen, and mounted on an SF-4 Sonntag fatigue-testing machine operating at 60 cycles per second; provision was made for transmitting the vibratory force to a bit at the specimen face, for rotation of the bit, and for a superimposed static load; (2) a larger-scale, horizontal vibratory drilling tool capable of driving bits up to 3 in. in diameter; and (3) a still larger-scale drilling assembly mounted vertically in a limestone quarry and capable of driving a 4⅝-in. bit. A fourth unit is under construction for down-hole drilling with bits up to 10 in. in diameter.

When percussion is obtained by a vibrating tool, as distinct from a hammer-type of drill, the action may be of two types, depending upon the contact time of bit and rock during each cycle. If the static loading is sufficiently high, the force between bit and rock never drops to zero and we have 100 per cent contact time. If, on the other hand, the static force is less than the dynamic, the bit may actually leave the rock during a portion of each cycle and true percussion results.

It was found that no advantage was realized with a dynamic force considerably less than the static load. The dynamic force could be replaced with an equivalent static force by adding drill collar, and the same benefits would be derived. It was otherwise with fractional contact times. Fairly spectacular drilling rates could be obtained, with relatively low static, or drill-collar, loading, particularly when the rotation rate was sufficiently great as to give a favorable ratio of vibration frequency to table revolutions per minute, as mentioned previously in connection with the question of indexing.

Drilling rates increased slowly with frequency of percussion. However, other factors operate against proceeding to very high frequencies. One is the line loss in transmitting high-frequency electric power down-hole. Another is the high rotation rate that is required with higher frequencies to give effective indexing. At present, an optimum point in frequency range seems to be between 200 and 300 cycles per second. This might still further be modified by such considerations as the availability of 60-cycle current and equipment, which could be used to produce 60 or 120 cycles per second percussion.

Work in the quarry and laboratory indicates that, for drilling at such frequencies, new types of bits may be required. So far as drilling rate is concerned, noteworthy advances have been made. However, bit life is of equal importance and will be studied with the down-hole equipment.

Conclusion

The foregoing experimental investigation, together with a theoretical investigation of the resistance of rocks under conditions of percussion drilling, provides a basis for:

1. Determining measurable mechanical properties in terms of which the resistance of rock to percussion drilling can be expressed.

2. Determining the optimal conditions of operation of a percussion-drilling device.

3. Comparing such operation with that of the best conventional equipment for assessment of the potentialities of percussion drilling.

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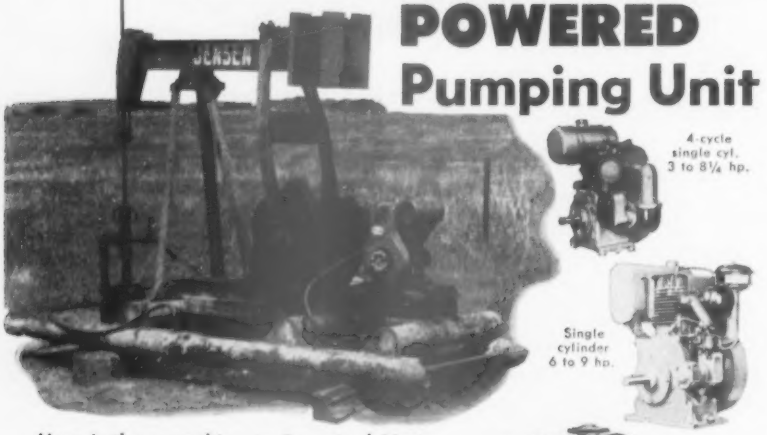
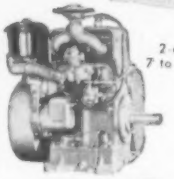
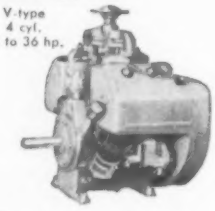


4-cycle single cyl. 3 to 8¼ hp.

Single cylinder 6 to 9 hp.


2-cylinder 7 to 14½ hp.


V-type 4 cyl. 15 to 36 hp.

Here is the next thing to *Perpetual Motion* . . . a Wisconsin-Powered Pumping Unit, mounted on a pipe skid frame, one side member of which serves as a casing-head gas volume chamber, tapping the well at one end and feeding a constant supply of "no cost" fuel to the engine at the other end. This unit is operating in the Oklahoma Osage Indian Reservation area, near Herd. This engine is equipped with a Combination Carburetor to permit operating on gasoline when the gas is "drowned out".

The versatility, economy and steady-going dependability of Wisconsin Air-Cooled Engines in oil field service, on all types of utility units, is today a firmly established tradition. The special suitability of Wisconsin Engines for this kind of service has been conclusively proved not only by performance records of many leading oil producers and pipe line operators, but also through continuous, actual field testing.

Any job that can be handled within a 3 to 36 hp. range, can be handled to maximum advantage with Wisconsin Heavy-Duty Air-Cooled Engine Power.

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on your { GASOLINE / BUTANE / or / DRY GAS } engine?

then you should use this MARVEL MYSTERY OIL in the Oiler!

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The *Marvel Inverse Oiler* is designed to feed *Marvel Mystery Oil* in exact proportion to engine speed and load. Prevents excess wear on valve stems and guides . . . keeps upper piston rings free to move in their grooves . . . retards ring flutter . . . and cushions ring pounding which can result in ring breakage. In addition, *Marvel Mystery Oil* reduces cylinder wall wear, and gives assurance against valves sticking. Remember, it is *the oil* which must do these things and only *Marvel Mystery Oil* is blended for this purpose and for this oiler. Over 30 years of exceptional performance.

This Chart shows the proper setting for constant load engines

BRAKE H. P. AT BELT	NAT. GAS CU. FT. PER HOUR	BUTANE GALLONS PER HOUR	GASOLINE GALLONS PER HOUR	M. M. OIL DROPS PER MIN.	M. M. OIL HOURS PER QUART
10	115.	1.07	1.12	4	228
15	172.5	1.60	1.68	6	152
20	230.	2.14	2.24	8	114
25	287.5	2.67	2.80	10	91
30	345.	3.21	3.36	12	76
35	402.5	3.74	3.92	14	65
40	460.	4.28	4.48	16	57
45	517.5	4.81	5.04	18	50
50	575.	5.35	5.60	20	45
60	690.	6.42	6.72	24	38
70	805.	7.49	7.84	28	32
80	920.	8.56	8.96	32	28
90	1035.	9.63	10.08	36	25
100	1150.	10.70	11.20	40	22
120	1380.	12.84	13.44	48	19
140	1610.	14.98	15.68	56	17
160	1840.	17.12	17.92	64	14
180	2070.	19.26	20.16	72	12
200	2300.	21.40	22.40	80	11
225	2587.5	24.00	25.20	90	10
250	2875.	26.75	28.00	100	9
275	3162.5	29.42	31.10	110	8
300	3450.	32.10	33.60	120	7

EXAMPLE:—If you use 805 cu. ft. of dry gas, 7.49 gallons of butane or 7.84 gallons of gasoline, your H.P. is about 70, so adjust oiler to feed 28 drops per minute. You will then receive about 32 hours per quart of MARVEL MYSTERY OIL.

If engine load increases after setting for normal load, oiler will automatically increase its feed, or decrease its feed when load is lessened.

When more than one oiler is used

To determine drop count per oiler when more than one oiler is used on an engine—divide recommended drop count by number of oilers.

NOTE: Guarantee on oiler is void if any other oil than MARVEL MYSTERY OIL is used therein. Some *engines* also carry this guarantee policy.

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Trans Mountain . . .

Lakehead .

Two 1953 Lines Typify Pipe-Line Progress

Only a short time ago these lines would have been considered impossible to build. But tougher jobs will arise in future, as oil and gas markets continue to expand.

by C. C. Bledsoe

PIPE lines are fast becoming the arteries of America, with their source in the oil and gas fields.

Since 1920 construction companies for building these arteries have emerged from a localized and little-known business to a multimillion-dollar business each year. Lines anywhere in the world are now economically possible. This fact is proved by the construction of the Trans Mountain Oil Pipe Line Co. across the Canandian Rockies and the crossing of the Straits of Mackinac by Lakehead Pipe Line Co.

To give some idea of the advancement in equipment, methods, and personnel in these 30 years, let us consider the major changes in the basic construction method.

Before 1920

Up to the year 1920 most lines were of the screw-connection type, which used a threaded joint, collar, or coupling to join the pipe ends together. Many of these lines were primarily gathering lines, with their destination a local refinery or loading point for railroads or barges. Generally, the companies did their own work.

Timber and brush were cleared by hand with cross-cut saws and axes. Fresnos were used when grading was done, with the ditch dug by hand. Mules, oxen, and horses were utilized in stringing the pipe and hauling other materials required on the line. Lowering in was by A-frames or mope poles placed over the ditch, with a block and tackle or chain hoist used to lower the pipe into the ditch. Backfilling the ditch was accomplished with a Mormon board.

It was during this period that the pipe-line contractor came into being. Many of them came from the companies where they had done this work; others from dirt or hauling contractors. In the begininng these contractors confined themselves to an area in which they were familiar with labor and ground conditions.

1920 to 1937

In the years fom 1920 to 1937 major changes in pipe-line construction came about, and during this time the industry reached its largest growth, percentagewise. Aerial surveys of the line by companies and contractors alike became common. Contracts became more standardized, and contractors started doing work all over the country—moving their heavy equipment by rail and truck.

Stringing subcontractors, working under ICC hauling permits, followed the move of main-line contractors, and extended over the country. Dozers replaced mules and a fresno in the right-of-way work. Ditching machines and backhoes or pull-stroke ditchers, as they were -known at first, dug the ditch.

There were several changes in the method of bending pipe during this period. The original method of cold-bending, which was merely bending the pipe by the best method at hand, changed to fire bends. Usually this consisted of placing an old automobile casing under the part to be heated and burning it in this position to heat the pipe. This was later changed to wrinkle bending, whereby one-half of the pipe was heated by a torch on the side to be bent. The bend was made by power equipment or by lifting the pipe. Prefabricated bends were also in use during this period from 1920 to 1937.

Major changes . . . The major change was in the way the pipe was joined. At first the screw couplings were acetylene-welded to cut down leakage. This was quickly changed to acetylene-welding the pipe together to save the cost of pipe as well as shipping charges. In welding, one of three common-type joints was used: plain ends that were butt-welded; bell-and-spigot ends that

Author is associated with Midwestern Constructors, Inc., Tulsa. Paper presented at a pipe-line symposium, annual meeting A.P.I., Chicago, November 10.

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were lap-welded or the bell-and-spigot type of joint with a dam.

The most common was the bell-and-spigot. The dam was merely a ridge on the spigot end of the pipe. Its purpose was to reduce the time of welding and the amount of rod, and to insure that the spigot was to the proper depth inside the bell end of the pipe.

Electric welding with bare rod came into use about 1928, and for quite a few years it was hard to tell which would become the standard of the industry—acetylene or electric welding.

At that time there were two basic methods of welding procedure: (1) the firing-line and, (2) the stove-pipe methods. In the firing-line method—the original one—the pipe was roll-welded into 200-ft. lengths, which were then strung on skids over the ditch and then bell-hole welded together. In the stove-pipe method, which was more suitable for rough country, the pipe was welded together one joint at a time to make a continuous line.

This eliminated the need for a line-up crew and its equipment. Another advantage was that it was not necessary to get some 200 ft. of pipe lined up, gun-barrel straight. This made stove-piping particularly adaptable to rough country. Stove-piping was first used in 1933 near Turnertown, Tex., on a line for Parade Gasoline Co. It was an idea of Carl E. Wharton, engineer in charge of construction.

Typical crew . . . A typical firing-line-type of welding crew consisted of a foreman, two bell-hole welders, four roll-welders, two helpers, one tack welder, and six line-up men. Immediately after the welding together of the 200-ft. string of pipe, caps were placed on the end, and the line was usually subjected to an air pressure of 50 psi. and then soap-tested. After this test, the bell-hole welds were made.

Equipment was mounted on oil-field wagons. Mules were used at first for motive power. In acetylene welding, the oxygen was supplied in cylinders, and acetylene by a generator mounted on a wagon. Welding machines were sometimes mounted in the hood of a tractor of the wheel type, or two to a wagon. Later they were skid or wheel-mounted. Electric welding was done by the uphill method with the "Crockett" grasshopper used to get a line-up.

During this period protection of pipe was recognized to be of major importance in keeping future maintenance costs low. Prior to this time a cold application of coating had been used. Later, a hot application of bituminous material with an outside wrap was applied on top of a primer. The purpose of the primer was to bind the coating to the pipe. This primer was applied by a compression type of spray gun. A coating machine, the prototype of the ones in use today, was designed with a chamber which connected to nozzles that sprayed the pipe. A drip pan below caught the runoff and returned it for use. These machines were designed to travel on the pipe; however, it was necessary to raise the pipe in front of this machine.

Wrapping was first applied by hand. Then came a manually operated metal framework to which two rolls of wrap were attached. By rolling this framework around and around the pipe, the pipe was covered with the wrap.

Sideboom tractors were used in lowering the pipe into the ditch. At first the boom or A-frame was placed on the front of the wheel type of tractor; later it was changed to the side of the crawler type of tractor. It was common practice to use a stiffleg with the A-frame of the sideboom in order to increase the lifting power of the piece of equipment.

More attention was given to backfill and cleanup, because damage claims rose rapidly during this period. A backfiller mounted on a crawler tractor, similar to those in use today, was used on backfilling operations, with a dozer for cleanup.

By this time pipe-line construction required such specialization that many men were making it their life work. These men were attracted by the opportunity to make large sums of money on an investment in a short time, by the high wages, and by the tremendous expansion of the industry. These same conditions prevail today.

Since 1937

Since 1937 the growth of the pipe-line industry has been phenomenal. With the knowledge gained through previous years, it is now possible to lay pipe lines almost anywhere. However, the cost of laying some of these lines is a staggering amount. In the early days you could lay lines for 10 cents a foot; today some lines cost in excess of $10 a foot. These prices cover only the cost of the labor contract, and do not include the cost of right-of-way or materials.

Before the bidding of a line today, it is preferable to fly and drive over the proposed route — with attention given to any unusual condition. In estimating the needs for water crossings, it is highly desirable to talk either to the dredging or to the bridge contractors who have worked in the immediate area.

Angle dozers and bulldozers up to 140 draw-bar horsepower have replaced the smaller-size dozers on right-of-way work. These giants are one of the main reasons it is possible to clear a right-of-way in almost any type of terrain. Gasoline-powered chain saws make it possible to clear timber rapidly, and motor-driven augers and other small tools have made it possible to quickly install gates in fences.

" . . . in the early days you could lay lines for 10 cents a foot; today some lines cost in excess of $10 a foot. These prices cover only the cost of the labor contract, and do not include the cost of right-of-way or materials."

Major advances . . . Major advances have been made in equipment to take rock out of the ditch. Rippers have become common and, in some parts of the country, have increased the production of backhoes and ditching machines 100 per cent. One of the latest pieces of equipment to facilitate removal of rock by blasting is the quadruplicate rock drill that is held up by a sideboom tractor. This tractor pulls the necessary air compressors. These rock drills have a seat attached, with all controls necessary to manipulate them within the operator's reach. Much of the originality of this idea may be attributed to M. T. Wilhite.

Another improvement in the equipment for drilling rock is the hydraulically controlled rock drill mounted on a movable framework attached to the side of a crawler tractor. The tractor has an air compressor on the back of it connected to the power takeoff. This machine permits rock drilling from a horizontal to a vertical position. Credit for this very recent improvement should go to Joy Manufacturing Co.

Ditching machines capable of digging a trench 54 in. wide and 10 ft. deep have helped toward the economical laying of big-inch lines. These are supplemented in rough country by specially designed backhoes. The recent tendency has been to use tractor-type tracks on backhoes and clams.

A major change has come in bending. Almost all bends are now made cold, either by using a bending machine or a shoe mounted on a sideboom tractor. The work of an engineer with the bending crew has proved advantageous in calculating the correct

number of degrees of curvature of the ditch. Working with the foreman provides the engineer with training for future advancement to a supervisory position.

Probably the most significant change has been in the operation of the welding gang. This method combines the old stove-piping and firing-line methods, and consists in placing one joint at a time in a continuous line, but not completing the weld and leaving the welds to be finished by a crew of welders—known as the firing line. The method first came into use in the late 1930's and much of the originality may be attributed to T. R. Jones and H. C. Price.

Gasoline or diesel-driven generators supply the necessary current for the electric welding, and almost every line is electric-welded now. These machines are mounted on a four-wheel rubber-tired wagon, and are pulled into position by a tow-cart or farm tractor.

Other Improvements

Another recent change in welding procedure is the use of hot-pass welders immediately behind the stringer-bead welders. This was necessary to keep from cracking the stringer-bead welds in high-tensile pipe and from preheating the pipe. To keep production up, it has become common practice to use three or four stringer-bead welders, thus eliminating one of the bottlenecks of the former procedure. Credit for eliminating this bootleneck is due Carl Stanley.

Many improvements have been made in small tools to facilitate the speed required in welding. Among these improvements are the internal line-up clamp, brought into use by H. C. Price, which eliminates the need to tack-welded the pipe, and the small buffing machine, which cleans the welds between passes. But, in spite of many improvements, there has been nothing to replace the 4 by 6-in. oak skids.

Protection of pipe—by coating or cathodic means, or both—has become practically universal. To clean the pipe and apply the primer, a traveling-type cleaning machine is run on the pipe, with an attachment that applies the primer. A recent development has been to run the exhaust from the engine through the tank to heat the primer, thus increasing its viscosity and making a more uniform thickness on the pipe. A sideboom tractor is used to cradle the pipe in front of the cleaning machine.

In the coating process a sideboom tractor is used to cradle the pipe ahead of the coating machine, and either one or two sideboom tractors equipped with belt slings are used behind it. The coat and wrap machine is capable of coating and applying two different wrapping materials to the pipe at the same time. Many technical advancements have been made in equipment used in this process, among which are: (1) the propeller and sweep agitators; (2) rubber crawlers on the traveling-type machines to keep from gouging the pipe; and, (3) a holiday detector to reveal thin spits in the coating.

Lowering in pipe . . . The lowering in and tying in of the pipe have been combined into one operation in recent years, except where there are a large number of ticins to make. The equipment in this operation usually consists of three sideboom tractors and one or two clams for digging out plugs which might be left in the ditch.

The backfill and cleanup operations are basically the same, with the addition of a farm tractor and disk to return the ground to its previous condition as nearly as possible.

Testing of the line has become more thorough. A pig is pushed through the line under air pressure to clean it, and then an air test is given for a certain time length. Hydrostatic testing is also prevalent in some parts of the country.

Settling damage claims has become a serious expense now. Almost every contractor employs a man in the field to take care of these problems.

The tremendous size of a big-inch crew and the numerous regulations now in effect have made the hiring of very competent office managers a necessity. Spread offices are now equipped with the latest calculators, adding machines, and typewriters in order to keep up with the volume of paper work.

Living quarters and food must be provided the crew in some isolated areas. But generally the men themselves, who are forever moving, have taken to mobile homes or trailer houses to keep their families with them. These people have entered and engaged in many activities together to build a happy home life.

At this point I should like to tell about some of the engineering problems that were overcome in the recent building of two pipe lines that only a short time ago would have seemed impossible.

Crossing Straits of Mackinac

First, is the crossing of the Straits of Mackinac: This job was handled by Bechtel Corp. as agents for Lakehead Pipe Line Co. Merritt-Chapman & Scott Corp. were the prime contractors, with the land and pipe work subcontracted to Midwestern Constructors, Inc., and the pontoons and launching equipment rented from Collins Construction Co.

The water in the straits is approximately 20,000 ft. from shore to shore, and 240 ft. deep at its greatest depth. The pipe used was 20-in. with 13/16-in. wall, built to specifications to insure good ductility and weighing 167 lb. per ft. The pipe was welded into eight 2,500-ft. lengths for each of the two lines and coated with a coal-tar enamel, then double-wrapped.

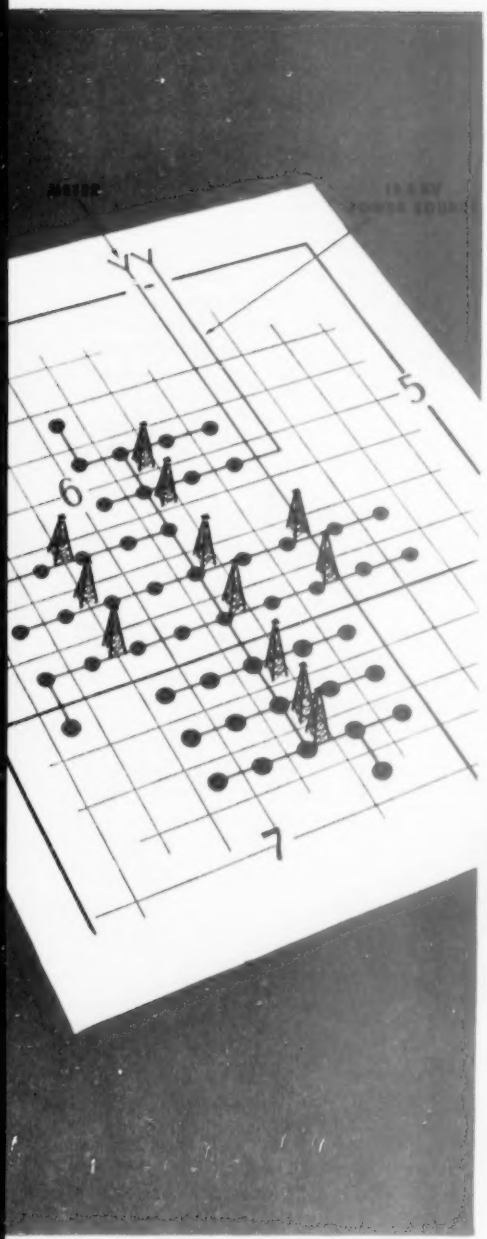
Slats were first applied to the whole line, but later they were taken off when it was discovered that water-soaking of the wood added too much negative buoyancy to the line. Therefore, the slats on the top half were removed. Pontoons were attached to the pipe by steel bands which passed through a release mechanism to give it a negative buyoncy of 5 to 6 lb. per ft.

This decreased the amount of tension necessary to move the pipe across the straits, lessened the chances of rubbing the slats off the pipe, and (with the pontoons attached to the top) tended to keep it from twisting by exerting an upward pull. Attached to each large pontoon was a small buoy, which in turn was attached to a tripping line tied to the pipe. When the line had been pulled across, the tripping line was pulled, thus releasing the small buoys, which came to the surface with a 1-in. rope. The other end of this rope was attached to the release mechanism; hence it was only a matter of pulling this rope to release the pontoons. The two launching platforms consisted of a steel framework, pin-connected in the middle to a steel base, which permitted it to pivot. By the use of these platforms, the pipe was prevented from buckling as it entered the water. One of the platforms was mounted on pontoons approximately 50 ft. from shore.

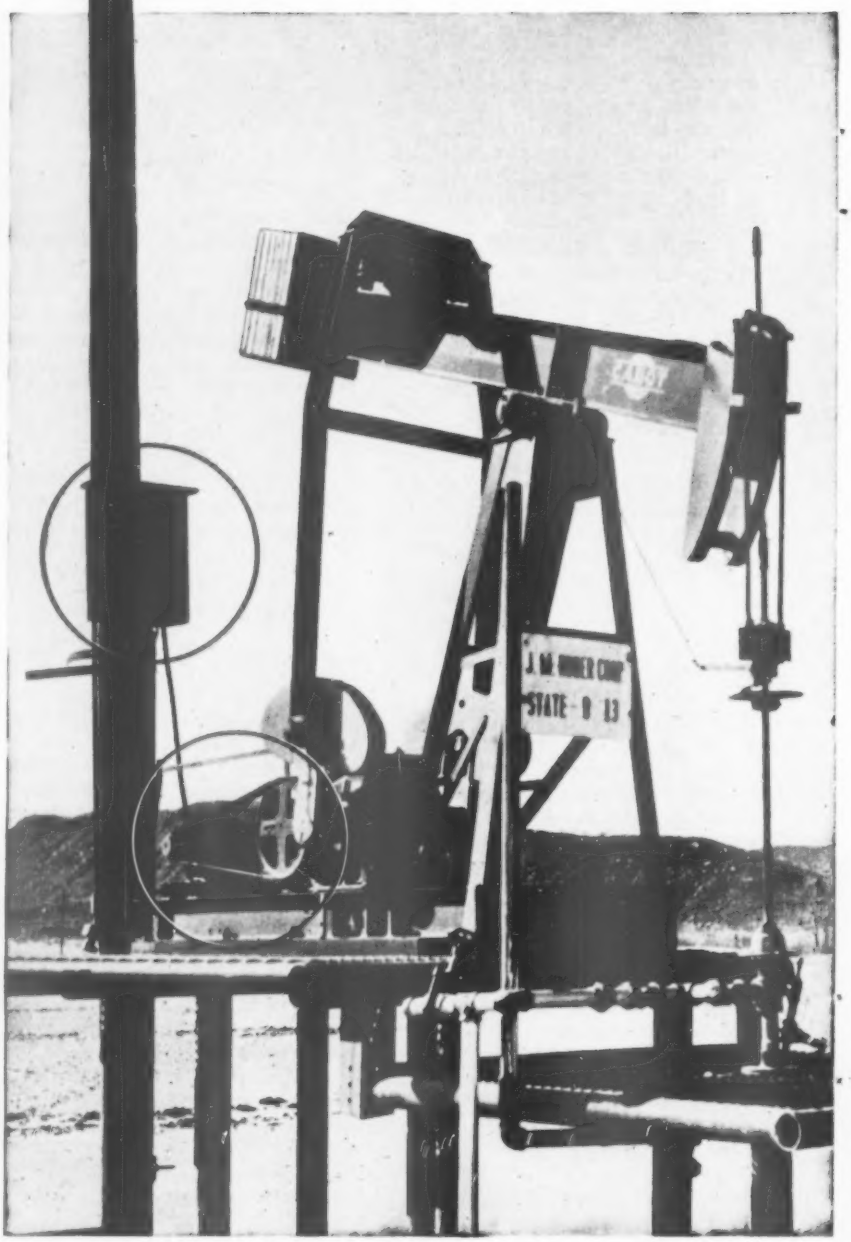
Pulling cable . . . The pulling cable consisted of six lengths of 2-in. cable and two lengths of 1¾-in. cable, all 2,500 ft. long, attached to a double-drum hoist. Each drum on the hoist had 2,750 ft. of 1¾-in. cable. As each 2,500-ft. joint of pipe was pulled into the water, a 2,500-ft. length of cable was taken out—this eliminated the need of spooling long lengths of cable. Buoyant mandrels were attached to every cable length, resulting in only 5 to 6 lb. per ft. of negative buoyancy of the cable. This kept the cable from digging into the bottom. Swivels that would turn on a 40-lb. pull were placed at every other cable length.

In order to settle the line on the bottom properly, a 4-in. line was inserted inside the 20-in. carrier pipe until it was at the low elevation as determined by fathometers. The line was

They did what you can do to reduce costs



Cost of the complete power line for these 49 Oklahoma wells was only $378 per well. Pumping cost is only 4.1c per bbl.



This Westinghouse-equipped pumping rig operates in *blowing sand* in a dry river bed. However, it has given 100% performance!

An opportunity for major cost savings in petroleum production

Have you really studied the dollar and cents advantages of electrified pumping? Look at these two examples from the Westinghouse files.

Operates under severe conditions

The photo at left shows a rig mounted on stilts in a dry river bed in Texas. The service conditions are terrible—sand blows constantly except during the rainy season when the river bed floods. Yet the Westinghouse motor and automatic time control have given 100% performance since they were installed two years ago. They haven't even required contact replacement. The automatic control cuts the motor in and out as desired, with just a rare check by the pumper.

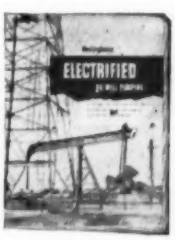
Pumps 49 wells for only 4.1c per bbl

But you don't have to have unusually severe conditions to make electrified pumping pay. A study of 49 wells in the Healdton field in Oklahoma, shows pumping costs of *only 4.1c per bbl.* Westinghouse automatic time control staggers the pumping load so that power load is just 47% of total connected load. The whole 49 wells are handled by one combination pumper-electrician. And the installed cost of the power line was only $378 per well, including transformers.

Call Westinghouse for planning help

Determining the best pumping method over the long run requires a careful economic analysis. It's a costly mistake to select equipment simply on the basis of what is easiest or cheapest to set up initially. Westinghouse would like to help you make the type of study that will show whether *you* can make major cost savings in your petroleum production. Call us in.

DO YOU HAVE YOUR COPY of this valuable guide on oil well pumping? Write for B-4039, "Electrified Oil Well Pumping," Westinghouse Electric Corp., P.O. Box 868, Pittsburgh 30, Pa. J-94908



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then filled with water, thus allowing it to settle in the sag first with the water going both ways toward shore. The soundness of this operation was shown by the fact that the pipe pulled toward the center 2 ft. on one end and 2½ ft. on the other. It was then hydrostatically tested to a pressure of 1,500 psi.

Because of the depth of water, only that portion of the line to the 65-ft. water depth was covered. The remaining portion of the line merely lay on the bottom, with dirt mounds placed over it to hold it in place. Despite the tremendous problems encountered, this crossing was made with very little difficulty. The first line took 164 hours to pull; but the second line took only 63 hours to pull because of improvements in operation.

Crossing Canadian Rockies

The construction of Trans Mountain's 711-mile 24-in. crude-oil line across the Canadian Rockies may be considered one of the great achievements in pipe lining. This project has taken 16 months to complete—including last winter, when it was necessary to shut down because of extreme weather conditions.

The timber was so thick in places that it required a crew of 200 men clearing and 24 dozers grading the right-of-way to make half a mile a day. About 100 fast-running streams with currents up to 12 m.p.h. were encountered—along with swamps, muskegs, mountains of solid rock, and steep bluffs. Landslides were the greatest hazard, with falling rock causing a large number of accidents. Rock was so bad that a total of 220,476 lb. of powder were used in 470 miles.

Where there were no roads, we used a helicopter for supervision and inspection of the line. There was such a lack of roads that in many areas the only road was the one we constructed. Because of the roughness of the country, there were 65 to 70 bends to a mile of pipe.

Camps were one of our major problems, because we had to provide the equivalent of a small town for the personnel on the job. Trailers with space for 12 men were provided for sleeping. Dining halls, kitchens, offices, warehouses, and other structures were also built. Power was provided for lights, communication, and machinery. In spite of all these handicaps, the job was finished ahead of schedule.

In the future pipe lines will be built in more difficult locations than the two just mentioned. But no matter how large or how difficult the job may be, the pipe-line contractors will be here to help and serve the oil and gas industry in the search for new markets.

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OIL and the ATOM

. . . Partners . . . or Competitors?

Both are here to stay, and can live and work together profitably

by W. L. Davidson

THE partnership between oil and the atom is proved by the many examples of the usefulness of the "atom" to the oil industry. In geophysical exploration, drilling, production, pipe-line transportation, refinery practice, and research, atomic-energy techniques and byproducts have been seized upon by the petroleum industry and turned to good use.

As competitors, the case for the atom rests on future developments which will require years of experimentation and experience. In only two cases is there a reasonable, immediate hope for atomic power. The first concerns locations remote from supplies of conventional fuels where modest electric power requirements (5,000 to 25,000 kw.) are met by diesel units today. And the second, viz., submarines, removes economic considerations in favor of national security.

However, should the atomic energy act be modified to remove the AEC monopoly on ownership of facilities for producing fissionable material itself, industrial interest and participation in these activities would be stimulated. The difficulties arising in such a policy change should be surmounted.

Oil-Industry Applications

The atomic energy program to date has borrowed many of the material-handling and process-control techniques common to the refining industry; and, conversely, petroleum people have been quick to seize on applications of atomic energy developments and byproducts to assist in increasing the efficiency of your own operations. Following are some of the ways in which atomic energy has already been, or is expected to be, put to use in the petroleum industry.

Author is director, Office of Industrial Development, United States Atomic Energy Commission, Washington, D. C. Paper presented before the transportation session, A.P.I. annual meeting, Chicago, November 9.

Geophysical prospecting . . . Oil, like gold, is where you find it. Furthermore, as time goes on, it is common knowledge that finding new oil fields is becoming more and more expensive. One interesting new technique which offers promise in reversing this trend involves flying low over a land area holding geological promise for oil, plotting the radioactivity registered by a scintillation counter mounted in the plane. The counter responds to the radioactive material in roughly the top 4 to 6-ft. layer of earth directly under the plane.

It has been noted that the ground surface surrounding known oil-field areas shows abnormally low radioactivity response. The theory underlying this phenomenon is that the radioactive content of surface soil is gradually leached out by rainfall and surface-water runoff, but that this is normally replaced by a gradual diffusion of ground water from deep in the earth, the latter containing traces of radium chloride. An oil pool effectively blocks this replacement diffusion process and, consequently, the ground above such an oil pool will have less than its normal content of radioactive material. If this technique lives up to its initial promise, the ratio of producer wells to dry holes drilled may be upped considerably.

Drilling . . . Once an oil well has been drilled, atomic energy techniques can also be used to learn something about the surrounding strata encountered in the well. For many years it has been known that formations of shale and granite are generally associated with a higher natural radiation intensity than, for example, rock salt, limestone, water, or oil. The conditions more favorable to encountering oil are those in which a fluid-filled, porous zone occurs between two layers of hard rock. (Unfortunately, such zones may also contain water.)

Gamma-ray logging has, therefore, been used to detect changes in the overall radioactivity of the strata as a function of the depth of the well. The sequence of such changes is compared carefully with other producing wells in the same general area, paying particular attention to sharp minima in the activity.

By means of a relatively new bombardment technique, a further differentiation can be made, inasmuch as hydrogenous materials such as oil or water react quite differently when bombarded with a stream of neutrons than do nonhydrogenous materials such as granite, sand, limestone, or salt. A stream of fast neutrons impinging on a nonhydrogenous target of reasonably high atomic number emits high-energy gamma radiation through a neutron inelastic scattering process.

This secondary gamma radiation can be recorded by suitable radiation-detection instruments. Neutrons striking a target rich in hydrogen atoms are slowed down and absorbed. The secondary gamma radiation emitted in this case is much less energetic, and the reading on the instrument is, therefore, reduced. This principle is used today to supplement the ordinary gamma-ray log.

A combination of a high primary and a high secondary gamma radiation

indicates that the stratum is probably granite. Within such a stratum, a localized combination of a low primary and a low secondary gamma radiation indicates a porous zone which may contain oil (or water). A high primary and a low secondary gamma radiation may indicate a shale formation. Other combinations indicate the presence of salt, limestone, or sand.

One of the several advantages of the gamma-neutron well-logging method is that extremely accurate records can be kept of the position and thickness of the strata. It is, therefore, possible by gun-penetration methods to open the casing at precisely the point corresponding to the hoped-for oil-bearing layer. It is likewise possible to seal off water-bearing layers. The accuracy in location is said to be 2 ft. regardless of the depth of the well.

Acidizing controls . . . Another way in which the byproducts of atomic energy are being used to help the petroleum industry is in the control of oil-well acidizing. As most of you know the rate of flow of an oil well depends, among other factors, on the porosity of the formation. This porosity is reduced with age as particles of limestone or dolomite are deposited in the interstices. When production drops to an uneconomical level, the well can be treated with 500 to 3,000 gal. of 15 per cent hydrochloric acid, under pressures as high as 2,000 psi. to dissolve some of the calcium and magnesium carbonates and reestablish the flow.

This process, called oil-well acidizing, has been in use for the past 20 years. To avoid wasting most of the acid on nonproducing limestone formations, it is necessary to control accurately the position of the acid in the well. The well is filled with oil, and the acid is introduced into the bottom of the well through a 2-in. tubing within the casing. The oil, being lighter than the acid, is displaced upward into the annular space around the tubing.

When the acid reaches the desired level, i.e., covering the suspected oil-bearing formation, pressure is applied to the oil-filled annulus by a pump truck at the surface. This holds the acid-oil interface at the desired depth in the well. If the pressures exerted both by the acid pump truck and the oil pump truck are increased properly, the acid can be injected into the formation in a controlled, desirable manner.

Numerous methods have been used in the past to establish the position of the acid-oil interface in the annular space, but most of these have not been very satisfactory. Today a small quantity of radioactive iodine is added to the hydrochloric acid. The position of the acid-oil interface is controlled by the response of a Geiger counter lowered within the inner tubing to the desired level. The inner tube is filled with radioactive acid, which results in a rather high but steady background, and the meter then responds to the rise and fall of the acid-oil interface in the annular space between the 2-in. inner pipe and the outer casing.

By the use of the radioactive isotope method, it is not necessary to remove the inner tubing. This technique has been in routine use in the oil fields of Kansas and Oklahoma for more than 2 years. In at least one case, I understand, an abandoned field has been reactivated, and is being redrilled as the result of information gained by this type of operation.

Pipe-line transportation . . . I am sure all of you in the Division of Transportation of the American Petroleum Institute are familiar with the use being made of redioactive substances to mark the interface between two types of petroleum product flowing in a pipe line. Two main advantages are realized from this. First, the interface is located at the receiving station much more rapidly and accurately than before; and, second, it simplifies enormously the complex task of pipe-line scheduling when a single pipe line is used to transport a dozen or more different products to be delivered to various customers.

I have heard that in one pipe-line system extending 560 miles from Salt Lake City to Pasco, Wash., each use of the radioactive marker technique has saved approximately 150 bbl. at a reprocess cost of $1,500. On this basis, it is stated, the cost of the measuring equipment was recovered in approximately 1 week of operation. It has also been found possible to use the gamma radiation from the marked interface to start and stop pumps automatically.

Radioactive Tracers

Another use of radioactive material associated with the petroleum industry and now considered classic is the measurement of wear and lubrication in a test engine containing radioactive piston rings. These piston rings are irradiated in a nuclear reactor, and thus some of the atoms in the iron become radioactive. The lubricating oil under test is added to the assembled engine, and the radioactivity of the oil is measured as the test proceeds. The engine need not be dismantled between measurements, and the same irradiated piston ring may be used in from 50 to 100 tests.

The sensitivity of the method using a scintillation counter is such that significant measurements of wear can be determined after a running time of but 15 to 30 minutes. It is, therefore, possible to measure rapidly the effect of engine loads, speed, water-jacket temperature and, of course, variations in the lubricating efficiency of different oil formulations.

One West Coast oil company has estimated the savings possible in carrying out a test program which normally would have cost $1,000,000 by conventional test methods and would have required 60 years' effort with the equipment available before the advent of radioactive tracers. This isotope technique was instrumental in obtaining the same information in 4 years, with the research budget totaling $35,000.

Still another place where radioactive tracers have been used to advantage is in measuring the circulation rate of catalyst beads in large petroleum catalytic crackers. For example, one oil refinery has tagged some of the catalyst beads with radioactive zirconium —95 and measured the emitted gamma radiation through the walls of the reactor to obtain the circulation rates directly.

One ring of Geiger counters is fastened around the top of the catalyst chamber, and a second ring around the bottom. When one of the radioactive beads passes the first ring of counters, the counter response is registered on a meter. When the same bead passes by the second ring, the meter is again actuated, and the elapsed time between these vents is noted. From the elapsed time and the known weight of catalyst between the two rings, the circulation rate, in tons per hour, can be obtained quite simply. The equipment described is now in routine use in almost all of the Houdry plants operated by this particular company.

In one outstanding case, in a Salt Lake City refinery, the cracking operations were producing off-specification gasoline. The radioisotope method was brought in as an emergency measure, and was credited with removing the difficulty within 24 hours, saving replacement of 4 to 6 tons per day of catalyst at $300 per ton and averting a shutdown estimated to cost $100,000.

Also in the refinery . . . One of the

". . . one oil refinery has tagged some of the catalyst beads with radioactive zirconium-95 and measured the emitted gamma radiation through the walls of the reactor to obtain the circulation rates directly."

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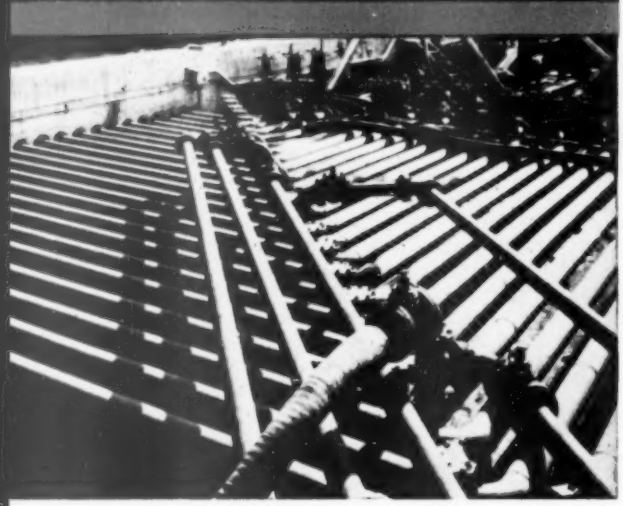

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important future methods by which solid hydrocarbons will be converted to liquid fuels is through the so-called Fischer-Tropsch synthesis. This, of course, involves the reaction of carbon monoxide and hydrogen in the presence of an iron catalyst to form, among other things, saturated hydrocarbons. The mechanism whereby hydrocarbons are produced from this reaction is not clearly understood. One theory suggested that this reaction might proceed by way of metal-carbide formation, with subsequent reduction of the carbide by hydrogen.

To determine if this possibility might be correct, an experiment was carried out whereby some of the catalyst was initially converted to carbide utilizing carbon-14, a radioactive form of carbon. This carbide was then used as the catalyst for preparation of product hydrocarbons. The radioactivity of the resulting hydrocarbons was practically zero—indicating that very little, if any, of the reaction took place through an intermediate carbide step. While not explaining how the reaction does occur, this did eliminate one possibility.

And, further, in research . . . Yet another use of an atomic energy technique was recently carried out in a research project which tended to show that petroleum is being created even today in the material being deposited on the ocean bottom. Only very slight concentrations of hydrocarbon were found in this muck, but nonetheless enough definitely to prove that such were present.

Of course, a doubting Thomas could always maintain this small amount of hydrocarbon could have diffused from oil pools far below the ocean bottom, and thus not correspond to new oil, but to conventional petroleum produced eons ago. To test this hypothesis, some of the "new" oil was examined by the very sensitive counting technique developed by Dr. Libby at University of Chicago to determine the age of specimens by their content of carbon-14. All living matter contains traces of carbon-14 made by the cosmicray bombardment of nitrogen in the air.

Ordinary petroleum which has been out of contact with living matter for many thousands of years shows practically no carbon-14 activity, because any present has long since decayed. However, this "new" oil turned out to have considerable carbon-14 activity present, thereby proving that it originated in comparatively modern times.

In the cause of peace . . . The fact that the petroleum business has discovered such varied uses for byproducts of atomic energy is most pleasing to those of us interested in promoting the peacetime atom. We fell that this points up the kind of worthy assistance the secondary products of atomic fission can offer numerous other industries, provided sufficient attention is given the matter.

It also serves as positive evidence that the petroleum industry—even for all of its 94 summers—is a keen, alert, fast-on-its-feet organization, eager and ready to take advantage of whatever new techniques basic science brings to the fore. This means that the petroleum industry should prove a worthy adversary in those areas where atomic energy will offer a challenge.

A possibility . . . In spite of my earlier statement that our two fields will not be generally competitive, there are several areas where competition to some extent seems inevitable. Even though atomic energy will probably not render obsolete any present equipment energized by fossil fuels, there are three categories where it is within the realm of possibility that future units may find atomic fuel more economical than a petroleum product. These include:

1. Oil or gas-fired boilers for process heat or electric power production (=100,000-kw. capacity or more).
2. Diesel-powered electric plants (5,000-kw. to 25,000-kw. capacity).
3. Large prime movers (ships, large aircraft).

This is all yours! . . . Because of "critical-size" considerations and shielding requirements, it is a fairly safe assumption that atomic energy will not compete with petroleum as fuel in the packaged-power field covered by units of 1 to 1,000-hp. equivalent. This means that automobiles, trucks, tractors, small naval craft, most aircraft—and probably even locomotives—as well as home-heating units, are not economically feasible with atomic energy. And, of course, by the very nature of things, you petroleum folks have no cause to fear that atomic energy can preempt any of the growing petrochemical field.

Consequently, it is clear that a goodly percentage of your present outlets for petroleum products will remain unchallenged, irrespective of what striking advances occur in nuclear science and technology. Even the areas of possible competition which I staked out above are at best academic in character today, and will require years of experimentation and experience before materializing into concrete threats.

It is to be noted, however, that methods of transportation are within, as well as beyond, these areas; and, for this reason, progress in the industrial development of atomic energy should be of considerable interest to you. Let us analyze how each of the three categories stacks up at the present time.

Atomic Potential

1. Central-station power plants . . . Coal is the predominant fuel for most large central-station thermal electric plants in the United States today. However, in a few regions—notably the Southwest and the Far West—natural gas and fuel oil are employed. The average cost of a kilowatt-hour of electricity generated in large United States plants is about 7 mills. The fuel costs a little more than 3 mills; fixed charges, i.e., cost of money for capitalization of plant, depreciation, taxes, profit, and insurance, account for a little less than 3 mills; and operation and maintenance average 1 mill.

The President's Materials Policy Commission, in its report submitted last year, indicated that adequate supplies for fossil fuel would be available to provide all United States electric power requirements for the next 25 years, and at real costs not substantially greater than exist today. Consequently, if large nuclear power plants are to gain a foothold in our country during the next 2½ decades, they must generate electric energy at a cost not exceeding the 7-mill figure. Can this be done?

To answer this query, we must first acknowledge that nuclear power plants will look and function very much like conventional power plants, the major difference being that the boiler and coal-handling facilities of the conventional station would be replaced by a nuclear reactor and accompanying heat exchanger. As yet we know of no practical method for converting fission energy directly into electric energy.

To a degree, this helps define the problem because we can then get a line on the situation by determining what one could afford to pay for the reactor and nuclear fuel in order that the total cost of power be 7 mills per kilowatt-hour. The Government has not yet set a price on natural-uranium fuel rods for power reactors, but a figure which is deemed reasonable by a number of people who have speculated on this subject is $35 per pound.

If we assume that, as a practical matter in a converter-type solid-fuel reactor, 1 per cent of the uranium atoms present can be split before the buildup of fission products and radiation damage require that the fuel rods be removed from the reactor and thrown away, the resulting fuel cost turns out to be 1.3 mills per kilowatt-hour.

It might seem that we are being profligate in suggesting that the spent fuel rods be thrown out when they still contain roughly 99 per cent of the ura-

nium charged. However, in view of the intense radioactivity of the fission products present, and the reduced content of fissionable atoms in the rods, it appears that the cost of recovery of uranium by present processing methods would be greater than simply purchasing new fuel rods. Perhaps the term "throw away" is an unfortunate choice of words here because the spent fuel can be stored for later recovery if and when the economics of the situation warrants such action.

This, of course, ignores possible credits for the fission products or a premium price for the contained plutonium, but it is not clear that either of these products merits serious consideration at the moment. Thus far the outlook for nuclear power seems favorable, inasmuch as we are saving roughly 2 mills per kilowatt-hour in fuel cost. However, this optimism fades when we start looking at the relative costs per installed kilowatt of a coal-fired steam boiler and a reactor plus heat exchanger.

The cost of the former ranges from $80 to $100. We have no comparable figures on power reactors, because no large central-station nuclear power plant has ever been built; but published "guesstimates" of the latter have been in the neighborhood of $500 per kilowatt. If we capitalize our 2-mill fuel savings—assuming 13½ per cent fixed charges, and that the plant operates 7,000 hours annually—we find we can tolerate spending an extra $100 per kilowatt on the reactor, or a total of roughly $200.

When this is compared with the $500 guesstimate, it seems clear that nuclear power is not competitive today if the above assumptions are valid. Obviously, the situation is not really this clean-cut. Perhaps a reactor can be built for less than $500 per installed kilowatt even today; maybe a more realistic price for uranium fuel elements is $20 per pound instead of $35. Perhaps one could run to 2 per cent burnup instead of 1 per cent.

Maybe there will be a market for packaged fission products, or a premium price might be offered for plutonium begyond its ordinary fuel value. These and other imponderables cause us to be hopeful that one day nuclear power will be able to stand on its own feet, but this day is evidently somewhere in the future.

2. Package power units . . . There are a number of locations, even in continental United States, which are remote from supplies of conventional fuels and yet do have modest electric power requirements. When the power need is in the 5,000 to 25,000-kw. range, it is most conveniently supplied today with diesel units, and the generating costs may run as high as 15 mills per kilowatt-hour, depending on the transportation costs for the fuel.

Owing to the essentially weightless character of nuclear fuel, 1 lb. of fissionable material possessing the heat equivalent of 1,300 tons of coal, considerable thought has been given to the possibility of developing a package nuclear power plant which might more readily prove competitive with small remotely located conventional plants than with a big domestic central-station facility.

Studies on paper indicate that a nuclear power plant would come close to hitting the target here, but the uncertainties are sufficiently great that no responsible private group has evidenced serious interest in tackling a project of this nature with its own money. Were the Government to finance a prototype unit of this size which showed power costs even marginally economic, it is felt that a number of industrial groups would then be willing to follow up with subsequent units entirely financed by private capital.

3. Nuclear power for propulsion . . . From a technical standpoint, it would seem far more difficult to perfect nuclear energy for the propulsion of vehicles and vessels than for the generation of central-station electric power. However, the cold-war urgency that our nation possess superior military might, and the accompanying relaxation of strict economic requirements as gaged by commercial standards for military prime movers, has enabled us to carry mobile reactor development to a more advanced state than the central-station analogue.

In fact, the STR* prototype unit has been operated successfully at the National Reactor Testing Station in Idaho, and it is fully expected that a nuclear-powered submarine will be plying the high seas some time next year. It has recently been announced that the "Nautilus" will be launched next January. The incongruity of this seeming paradox, wherein by joint AEC-Navy effort our nation has accomplished the hard task of building a compact power unit and yet still cannot see our way clear to tackling the seemingly easier job of building a central-station plant, can be rationalized from overriding military needs and by reference to the relative economics of the two applications.

The average power costs in a fleet submarine have been estimated by the U. S. Navy at some 8 cents per kilowatt-hour, an order of magnitude greater than that which would be considered justified for a large land-based commercial power plant. Beyond this, a superspeed chemically powered submarine has power costs another order of magnitude greater—approximating $1 per kilowatt-hour. Thus it is clear that, in this unique area, nuclear power offers great promise both from the standpoint of lower cost and premium performance.

*STR = submarine thermal reactor.

Still I think it would be erroneous to conclude that, just because atomic submarines are practical, economic nuclear-powered tankers and merchant vessels are on the near horizon. On the other hand, the success of the nuclear-submarine program reinforces our confidence in the technical practicality of mobile nuclear power plants, and represents the first milestone in an approach to commercial vessel powered with nuclear fuel.

At one time the U. S. Navy and the Atomic Energy Commission were pursuing a project for the nuclear propulsion of a large surface vessel, such as an aircraft carrier. Last spring a redetermination by the Department of Defense caused this military requirement to be withdrawn. However, in the course of the session just concluded, Congress authorized the expenditure of $7,000,000 for the initiation of construction on reactors which will contribute technical knowledge both to central-station power and the propulsion of naval vessels. Therefore, it may be expected that future work bearing on the development of mobile reactors for surface ships will continue, although at a reduced pace.

What does all this augur for you, who are concerned both with the transportation of petroleum in tankers and with the use of fuel oil by the U. S. Navy and the U. S. Merchant Marine? In the same vein as the restaurant owner who hung a sign on the door each noon "OUT TO LUNCH," will your tankers one day employ nuclear fuel to transport hydrocarbon fuel, or is this idea preposterous? At the moment nobody has the final answer.

Preoccupation of the Atomic Energy Commission with the pressing problem of assuring the common defense and security has prevented anything other than the briefest look at this possibility. It is of interest that a joint paper study of merchant-vessel propulsion by nuclear power is currently being initiated by the Atomic Energy Commission and the U. S. Maritime Commission.

To date, the only serious treatment of this general problem which has come to my attention is that carried out in 1951 by a group of Harvard Business School students under the direction of Prof. Georges Doriot. This study ap-

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pears as a chapter in the mimeographed publication, "Swords into Plowshares." They considered the feasibility of nuclear propulsion for dry-cargo vessels in the North Atlantic trade.

In view of the expected higher capital cost for a reactor system as compared to an oil-burning unit, it was decided at the outset that only for a really high-speed vessel (= 35 knots) would nuclear power be at all justified. This, in turn, demands a structurally stronger hull and twin screws, which make the basic nuclear ship considerably more costly than a conventional vessel of the same cargo capacity, even aside from the propulsion unit. Their basic analysis consisted in comparing, on an annual basis, the operation of a 20-knot C-4 "Mariner-class" dry-cargo vessel and a hypothetical nuclear-powered craft of equivalent cargo capacity boasting a 35-knot speed.

With this choice of equipment, a determination was attempted of the funds which a commercial ship operator could afford to invest in a nuclear-powered ship to realize the same percentage return on his investment as the Mariner would yield. The premise was that, given this equivalent return and the attendant advantages of higher speed, the choice would go to the nuclear ship.

Several important assumptions underlie the findings of this study:

1. It was assumed that, although the rated cruising speeds of the Mariner and nuclear ship were, respectively, 20 knots and 35 knots, adverse weather and harbor approaches would reduce their projected annual averages to 17 knots and 32 knots, respectively.

2. The assumption was also made that a nuclear ship will never be built without reasonable assurance of a volume of trade required to support it. Thus a hypothetical load factor of 95 per cent, somewhat above the stated breakeven point for current operating experience, was chosen for the nuclear-powered vessel.

3. The additional assumption was made that cargo-handling time can be significantly reduced in the future as more attention is directed to the techniques of materials handling and mechanization. The thesis was accepted that cargo handling could be carried out on a 3-shift, 24-hour basis, even though present union rules limit cargo-handling operations to a 2-shift, 16-hour basis.

4. The Harvard group further adopted the view that premium rates will be justified for freight carried at a higher speed. Justification for this is found in the higher rates secured for air freight. Purely on the basis of relative speed involved, they chose a 20 to 50 per cent premium over the conventional ocean rate for the particular route selected.

5. They believe that, in addition to the investment in the ship, an additional $5,000,000 is required for working capital and other facilities in both cases. This makes the total investment in a Mariner $13,500,000, as compared to a total of $19,000,000 plus the reactor and fuel inventory costs which can be assigned to the nuclear ship.

6. Finally, they concluded that no charge need be made for fuel consumption in the nuclear ship, because calculations suggested that such costs may be so low as to be negligible.

Two extreme cases were considered—one involving optimistic estimates, the other based on the more conservative appraisals. In Case I, cargo handling was assumed to be at the best attainable rate for general dry cargo on the basis of a 24-hour working day and a reduction in handling time by one-third as a result of increased mechanization. The highest possible premium for increased speed was assumed to be 50 per cent above the conventional trans-Atlantic ocean-trade rates. In the pessimistic case, cargo handling was still assumed to be on a 24-hour basis, but no reduction in handling time due to mechanization was allowed. Further, only a 20 per cent premium for increased speed was taken here.

Under the foregoing hypotheses and assumptions, the following conclusions were reached as a result of the study:

1. A 35-knot nuclear ship of approximately 25,000 tons gross weight will, when the cost of mobile reactors declines to levels between 4 and 15 million dollars, still represent a total investment between 25 and 35 million dollars. This figure is two to three times that required for a 20-knot Mariner of the same cargo capacity.

2. The useful work performed by any ship is strictly limited by the time spent in han-

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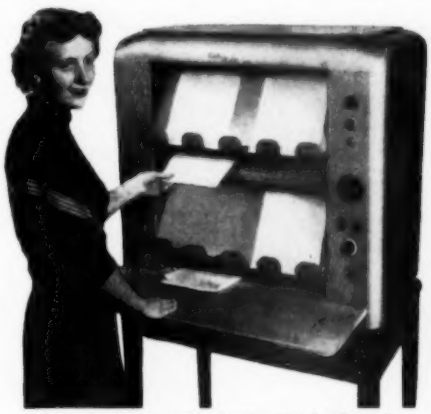

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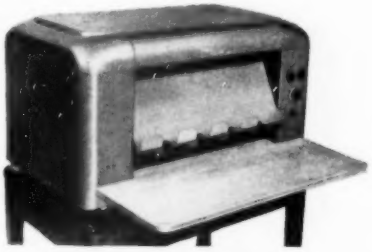

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dling cargo into and out of the hold. Without continuous 24-hour loading and unloading, the value of increased speed will be negligible. Even assuming continuous cargo handling on a 24-hour basis and conventional stevedoring, a 35-knot ship will annually move only 33 per cent more cargo than the 20-knot Mariner. Assuming a one-third increase in handling capacity from mechanization, a 35-knot ship will achieve only 40 per cent more tonnage than the 20-knot ship.

Hence, at comparable freight rates, the increased utilization resulting in a 40 per cent greater annual tonnage carried by virtue of the speed advantage will not in itself justify the investment in a nuclear ship. Of course, had consideration been given to liquid cargoes which can be unloaded in shorter times, the value of the increased speed would be definitely enhanced. Consequently it is clear that, had oil tankers been chosen for study, different conclusions might have resulted.

3. Justification for the dry-cargo nuclear ship and for speed in excess of that obtainable in the Mariner will depend heavily upon the availability of premium freight rates for the increased speed. Inasmuch as cargo-handling time is the same in both cases, even with the time at sea for the nuclear ship only a little more than half that of the Mariner, the net time saving to the customer is not great.

Yet, on the assumptions made in this trans-Atlantic example, the results suggest that the premium for the extra speed might have to be 40 to 50 per cent over conventional ocean freight rates. They, therefore, conclude that a sizable premium must be forthcoming, and that there is some reason to doubt that the shipper or customer would be willing to pay that premium.

4. The concept that larger ships and greater cargo capacities might permit further gains from a 35-knot speed is false. Although the prospects of a large increase in horsepower with relatively insignificant increase in the size of reactors strongly suggest the possibilities of larger ships, again it is cargo-handling time which governs. Thus doubling the size of the ship increases annual cargo by only 20 to 30 per cent, with the other stipulations as cited above. They, therefore, conclude that, if anything, nuclear ships will be somewhat smaller than the one patterned after the Mariner.

In view of the preceding, one arrives at the general conclusion that the probability of extensive use of nuclear power for high-speed surface merchant vessels in the near future is extremely nebulous. It might well be possible, however, to justify the use of such ships to a very limited degree on heavily traveled trade routes wherein particular commodities require the additional speed and will support premium rates.

A possible criticism of the study might be made on the grounds that it was unwise to select an example wherein the premium-speed factor would be largely offset by the holdup time in loading and unloading. As mentioned earlier, a tanker study might show results considerably more promising. On the other hand, it would be hard to rationalize any premium rate for the speedy delivery of a petroleum shipment so that the ultimate advantage of a nuclear tanker would depend on its greater annual tonnage.

Even assuming zero turnaround time for tanker operation, the nuclear vessel considered above would hardly double the annual tonnage carried by a Mariner tanker. Thus we would still be able to invest only about $4,000,000 in reactor and fuel to compete on an even basis. More promising results might be expected from a study of passenger-vessel traffic, where time is an important factor. Still I feel this study rendered a valuable service as the first serious approach to the question of nuclear power for merchant vessels.

It is also rather encouraging to note that, if a $15,000,000 investment in reactor and fuel inventory were permissible, this would correspond to an installed kilowatt cost of roughly $300. Although this is far below the $1,400 per kilowatt cost estimated for the first nuclear submarine, it does not appear to represent a completely unattainable goal at some future time, in view of the possible advances which can be expected in the technology of mobile reactor systems. I feel the ultimate promise of nuclear power for the propulsion of merchant vessels is sufficiently bright that you will wish to acquaint yourselves with such information as can be made publicly available

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Policy Problems Surmountable

My previous remarks on the possible commercial use of nuclear power units were devoted exclusively to the pertinent technical and economic factors. There is also the policy, or better phrased, the legal aspect to be pondered. Today it is academic to talk of commercial nuclear power because, by law, the Atomic Energy Commission has a monopoly on the ownership of facilities for producing fissionable material, as well as fissionable material itself.

Most people agree that this monopoly must be relinquished before sizable amounts of private capital will begin to flow into nuclear power development. The AEC believes this to be so, and is further convinced that it is now appropriate to modify the atomic energy act to promote industrial interest and participation in this activity. At the request of the Joint Committee of Congress on Atomic Energy, the commission last spring formulated and submitted to the joint committee a statement of policy which, if accepted by the Congress, would serve as a basis for enabling legislation.

During June and July just past the joint committee held a series of open hearings on the subject of atomic power development and private enterprise, in the course of which more than 100 witnesses offered testimony. It is impossible here to summarize the various viewpoints introduced at the hearings. Suffice it to say that a wide spectrum of opinions was voiced—so much so as to make it apparent that additional thought must be devoted to the problem by the legislators before deciding on a proper course of action. The 649-page volume, Atomic Power Development and Private Enterprise, detailing all contributions, is obtainable from the Government Printing Office (price $1.25). This is "must" reading for anyone who is seriously interested in the future of nuclear power.

I firmly believe the acknowledged policy difficulties to be surmounted in this area should not deter us in our quest for an equitable solution. Continued United States preeminence in nuclear science and technology is at stake here. The prodigious quantities of energy available from the splitting atom demand that its constructive promise be not ignored, just as the leading world powers have not dared to ignore its capacity for destruction. The policy problems, as opposed to the technical questions, are creations of man. Granted sincerity and a willingness to subdue personal prejudices, they can be solved by man.

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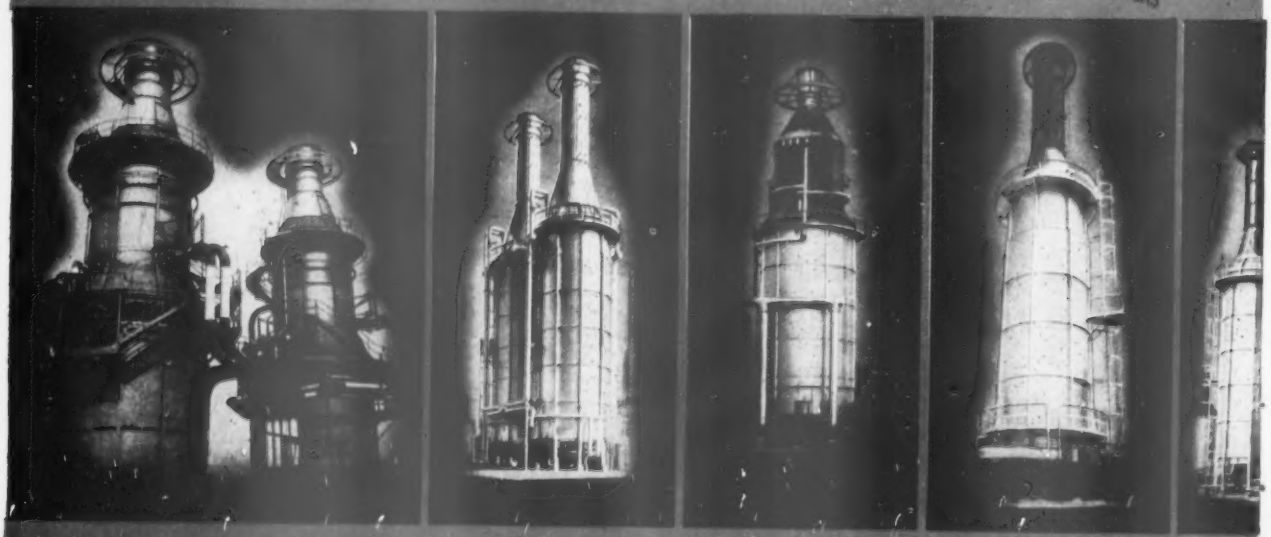

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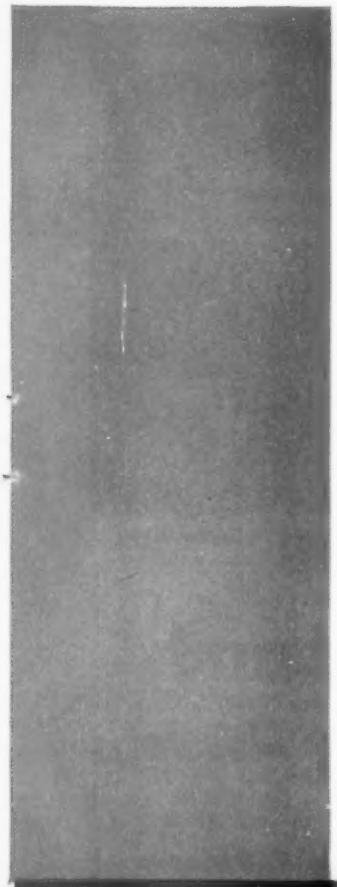

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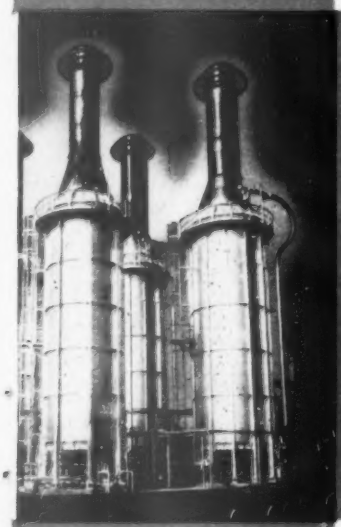

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As of June 30, 1953, there were 248 federal-unit operations in effect in the Rocky Mountain states. Total acreage within these units was over 4 million. During the year, nearly 72 million barrels of oil was allocated to federal lands.

How to Operate on Federal Lands

in the Rocky Mountains

When you do business with the Interior Department, you can expect to run up against some tough problems, but this author says most of them can be settled peaceably.

by Lon J. Putnam

OPERATIONS on federal lands in the Rocky Mountains bring about a number of problems between the U. S. Department of the Interior and the oil companies. However, these problems can usually be settled amicably. Representatives of the Interior Department have rarely if ever arbitrarily used their authority in these cases.

Primary concern of department representatives is the speed with which the area can be economically and scientifically developed so as to increase the net proceeds to all. These representatives are indirectly accountable to all parties committed to the unit, and they frequently receive protests from private owners regarding unit operations.

Scope of paper . . . This paper is limited to federal problems and does not go into state conservation regulations. The reason for the omission is that generally speaking, these regulations present no problem to the operators in the Rocky Mountain area. Probably, to date, New Mexico has gone further than any other state in the area; however, Montana is now considering the adoption of a set of regulations which will require some attention if approved.

Author is associated with Gulf Oil Corp., Denver, as federal unit coordinator. Paper presented before production session, annual A.P.I. meeting, Chicago, November 10.

What Are Federal Lands?

Actually, the term "federal lands" is quite broad in scope. It covers acquired lands; lands in our national forests and reclamation projects; lands in game preserves; national parks and monuments; public domain lands; and, to a certain extent, Carey Act lands.

Acquired lands are those lands which were originally a part of the public domain but later passed to private ownership, then were reacquired by the federal Government for a specific purpose. Except for certain lands located within incorporated towns, cities, national parks, and those used for military and naval purposes, these lands, by virtue of an Act of Congress[1] are now subject to lease by the Department of the Interior under the provisions of the Federal Oil and Gas Leasing Act.[2]

Lands which are a part of our national forests and reclamation projects may be leased by the Department of the Interior; but the leases, when issued, must have the approval of the administrative agency directly concerned and usually contain stipulations covering operations thereon.

Lands in game preserves and in national parks and monuments are not subject to oil and gas leasing in the usual manner. They require special consideration by the Department of the Interior, and when leases are granted they usually will be on a form which includes terms and provisions which will prohibit operations which interfere with the use for which the lands were intended.

Public domain . . . The term "public domain lands" applies to lands to which title has not passed from the United States. The leasing of these lands is under the jurisdiction of the Interior Department; and, because the procedure is thoroughly outlined in the federal regulations,[3] it will not be covered in this paper.

Carey Act lands originated under an act passed by the Congress on August 18, 1894.[4] In general it provides that, upon application of a state, the federal Government will convey desert lands not to exceed 2,000,000 acres. These grants are conditional and the state is

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2. This well was previously perforated by two different companies without results because of an excessively thick cement sheath behind the 7" O.D., 23 lb. casing. Six holes were shot between 6688 feet and 6690 feet with a 4¼" McCullough Glass Jet Perforator and Steel Strip Carrier. The well produced 50 B/D. Time on the job—two hours.

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required to undertake irrigation development within a specified period of time, plus allowable extensions. The reclaimed land was to be conveyed to settlers in tracts not to exceed 160 acres.

Actually, these land grants were grants-in-trust for a specific purpose. Also, within the acreage conveyed there was a portion which could not be reclaimed under an irrigation project and, therefore, was not subject to conveyance to settlers. The net result has been that a portion of these grants cannot be leased for oil and gas by the state because of the limitations imposed in the conveyance, and the federal Government is prohibited from doing so because of the conditional grant to the state.

Thus, a stalemate has arisen under which no oil and gas lease can issue. The Rocky Mountain Oil and Gas Association is currently making a study of this problem with the hope that some recommendation can be made for legislation which will remove the obstacle either in favor of the state or the federal Government.

Acreage limitations . . . One of the most difficult problems confronting operators on federal lands is that of acreage limitations. The Oil and Gas Leasing Act, as amended,[5] and the federal regulations promulgated thereunder,[6] generally limit to 15,360 acres the taking or holding of oil and gas leases or interests therein by a person, corporation, or association, and to 100,000 acres under 2-year nonrenewable geological or geophysical options in each state.[7] Because many of the Rocky Mountain states contain large amounts of federal lands, these limitations curtail the activities of many operators who are engaged in exploration work in the region.

There is one way by which the problem of acreage limitations can be minimized to some extent. The Oil and Gas Leasing Act, as amended,[5] and federal regulations[6] provide that, in order to conserve the natural resources of any oil and gas pool, field, or like area or any part thereof, lessees may unite in unit or cooperative plans of development and operation when determined by the Secretary of the Interior to be necessary or advisable in the public interest. The act and regulations further provide that federal lands operated under such a plan shall be excepted in determining holdings or control under the provisions thereof.

I believe that a few statistics will show the extent to which federal unit operations are being conducted in the Rocky Mountain states. The following figures are for the fiscal year ending June 30, 1953, and represent the combined totals for the Northwestern and Southwestern Regions of the United States Geological Survey:

1. Two hundred and forty-eight units were in effect at the close of the year.
2. The total acreage within these units amounted to 4,133,903 acres.
3. During the year, 71,844,537 bbl. of oil was allocated to federal lands; and, of that total, 34,352,691 bbl., or approximately 47.8 per cent, was allocated to federal lands under an approved unit plan.

These figures are still more impressive when we consider that the first unit was not formed until 1931 and the total barrels allocated to federal lands includes fields discovered prior to that date and which have not been developed under a unit plan.

Participation . . . At this time I should like to point out that, as a general rule, when we talk about federal units we are talking about units which cover entire geological structures. Also, our discussion will be devoted primarily to "unitization before the fact"; i.e., before discovery. Further, we must realize that participation in costs and benefits under this type of operation is determined by a second agreement which has been designated the "Unit Operating Agreement," provision for which is made in the standard form of unit agreement. Participation generally falls into one of two categories:

1. Divided interest participation which may be defined as participation in costs and benefits upon an acreage basis after the area is proved productive and upon the basis of sound geological and engineering data. Under this plan the area of participation may be enlarged, changed, or contracted as more development takes place and more data are available.

2. Undivided interest participation which may be defined as participation in costs and benefits upon a fixed or predetermined basis which is not affected by subsequent expansion or contraction of the productive limits of the unit area. It should be noted that the allocation of costs and benefits under this type of plan applies only to the working interests, inasmuch as the standard form of federal unit agreement provides for allociation of royalty upon the same basis as that outlined for divided interest participating units.[10]

Operating terms . . . At this time I should like to emphasize that negotiations covering the terms of the unit operating agreement represent the most difficult and time-consuming phase of forming a federal unit. In addition to basic differences in management policies, experience will show that there are two major stumbling blocks in negotiations. Usually the representatives present have little or no authority to act; they merely listen and report back to their respective managements who, in turn, must pass upon the form. Frequently these representatives become so concerned with the details of "pinching pennies" that they forget the overall benefits to be reaped.

"... there are two stumbling blocks in negotiations. Usually the representatives present have little or no authority to act. And frequently they are so concerned with the details of pinching pennies that they forget the over-all benefits to be realized."

The net result is that many hours are consumed over matters of detail which have little effect other than to delay the program of unitization. Second, there are within the group a number of legal representatives. In many instances valuable hours are wasted over wording and phrasing which, for the most part, merely amounts to the "crossing of the t's and the dotting of i's." These observations are not intended as a reflection on either group since many persons engaged in this type of work never follow the practice, but the points are made to show the unnecessary delay which a few individuals can cause.

The Rocky Mountain Oil and Gas Association has recently embarked upon a long and tedious project in which an attempt is being made to standardize the form of unit operating agreement. Many hours are yet to be consumed in working out this problem; but we believe that, if successful, it will eliminate a large portion of the hours and days previously lost in negotiation.

Standard agreement . . . In addition to the objections already mentioned, some people in the industry believe that the standard form of unit agreement delegates too much authority to the Department of the Interior in the arbitration of matters connected with unit operations. They are of the opinion that this authority, in many instances, permits the department to actually dictate on matters of substance. They further insist that, by adopting the standard form, the department has vested in

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the unit operator extremely broad powers in carrying out exploration and development programs.

In answer to these objections, I should like to emphasize that, even though the form does grant broad authority to the department, my experience has been that there are very few instances, if any, of an arbitrary use of that authority. The primary concern of department representatives is the speed with which the area can be economically and scientifically developed so as to increase the net proceeds to all. We can more fully appreciate this position when we realize that the department is indirectly accountable to all parties committed to the unit, and frequently receives protests from private owners regarding unit operations.

This is particularly true where the unit operator is dilatory in the performance of his duties. Also, one must admit that broad powers are delegated to the unit operator; however, as mentioned before, the standard form provides for a unit operating agreement in cases where the working interest is owned by more than one party[11] and its terms are always subject to negotiation. Experience will prove that, without exception, limitations will be imposed upon the unit operator which adequately protect the other parties. For this reason I believe that basically the principal objections evolve into objections which are, for the most part, theoretical or academic in nature.

Forming federal units . . . For the sake of brevity, I have purposely omitted the procedure to be followed in forming federal units because I believe this matter is adequately covered in the federal regulations[12] and state laws and regulations under which the various states have authorized their land boards to enter into unit plans.[13] Because I have taken this liberty, I shall now attempt to point out a few of the many advantages to be gained by operating under a federal unit plan.

In the first place such a plan permits the development of the entire pool in an orderly manner in conformity with the best engineering practices. I believe this fact is clearly expressed in a quotation from the report of the Federal Oil Conservation Board appointed by President Coolidge in 1924 which states: "The natural unit in oil deposits is the single pool, large or small, and unit operation is in essence nothing more or less than accepting nature's decree and seeking to work in harmony with it."

Unitization also permits uniform and proper withdrawal rates and each owner receives his equitable share of the economic benefits of the pool. Other advantages can best be emphasized by posing a few questions, viz.: Why should we competitively drill many costly wells in a pool when one-half the number will actually produce more oil? Why create duplicate investment costs when they can be avoided by unitization? Why let our natural energy be dissipated by selfish competitive methods when we have a device by which it can be avoided?

When one looks at the fact that many drilling projects are undertaken on an individual and competitive basis at the time when the operators actually visualize a future secondary-recovery project which, undoubtedly, will result in a consolidation of all facilities, the whole approach seems inconsistent.

Many times operators will object to unitization prior to production for various reasons; but when we look at the duplicate and excessive costs involved, it seems that we are straining at gnats and swallowing camels. Experience has proved that it is considerably more difficult to unitize a field after production than before. In support of this position, I offer as an example Rangely field in Colorado. Negotiations toward unitization of that field have been conducted for several years without success; however, I understand the operators are now much closer to agreement and prospects of unitization are much brighter.

References

1. Act of August 7, 1947, 61 Stat. 913, 30 U. S. C. 351 et seq.
2. Act of February 25, 1920, 41 Stat. 437.
3. Code of Federal Regulations; Title 43—Public Lands: Interior Part 191.
4. 28 Stat. 422, 43 U.S.C.A. 641 et seq.
5. Act of August 8, 1946 (60 Stat. 950) Sec. 27.
6. Code of Federal Regulations, Title 43 Public Lands: Interior Part 192, Sec. 192.3.
7. Id., Sec. 192.4.
8. Act of August 8, 1946 (60 Stat. 950) Sec. 17 b.
9. Code of Federal Regulations; op. cit., supra Sec. 192.3.
10. Id. Sec. 226.12 (11) and (12).
11. Sec. 226.12 (7).
12. Id. Sec. 226.1 to 17.
13. Laws of the State of Utah, 1945, Chapter 127 (86-1-48.25 Utah Code annotated 1943) authorizes the State Land Board to join on behalf of the State of Utah in cooperative or unit plans of development or operation of oil and gas pools with the United States Government and its lessees or permitees and others to facilitate the efficient and economic production of oil or gas; Wyoming compiled Statutes of 1945, Chapter 24, Article 7, Section 24-702 authorizes the Board of Land Commissioners of Wyoming to join on behalf of the state in unit or cooperative plans of development or operation of oil and gas pools with the United States or others to facilitate the efficient and economic production of oil or gas; New Mexico Statutes, 1941, 8-1138 cooperative operating agreements between lessees or others authorized permits unitization of state lands with federal and fee lands; Revised Codes of Montana, 1947, 81-1702 to 81-1724 permits the Commissioner of State Lands to join unit plans or operation where state lands are involved; Colorado Statutes annotated 1935; Laws 1947, p. 692, Ch. 248, authorizes the State Land Board to join in any cooperative plan for unit operation of a common source of supply of oil or gas with the United States or private individuals, and to make such modifications in leases as may be necessary to facilitate the unit plan of operation; Idaho Code 1947, 47-811, the State Board of Land Commissioners is authorized to enter into agreements with the United States Government and its lessees and permitees and with others for unit operation of oil and gas pools and may, with the consent of its lessees, modify existing leases for this purpose; Arizona Code annotated 1939, 11-1314, a lease or permit must contain a provision authorizing the department to require the lessee or permitee to join in a unit plan of development with the United States and its lessees and permitees, and with private owners; North Dakota Revised Code of 1943, 38-0903 North Dakota Leases for oil and gas made by any political subdivision may contain a provision for unit operation of the land leases, with other lands and the sharing of royalties by the lessee thereof in the proportion that the area of the lease bears to the consolidated or unitized area; South Dakota Laws 1939, Ch. 164, Sec. 1, The Board of School and Public Lands and the Rural Credit Board have authority to enter into agreements for the pooling of state and school lands under their respective jurisdiction with other lands for unit operation and for the apportionment of royalties on an acreage or other equitable basis.

BOOKS

TULSA GEOLOGICAL SOCIETY DIGEST, Volume XXI, 1953. 267 p. $2 plus postage from E. T. Peterson, in care of Atlantic Refining Co., 830 Kennedy Building, Tulsa.

The 1953 Digest of the Tulsa Geological Society is one of the largest volumes yet published by the society. More than 25 interesting geological articles appear in the 1953 Digest. Developments in the Williston, Denver-Julesburg, Uinta, and Anadarko basins are discussed in separate reports. Two articles on well logging; another on interpreting drill-stem test information, and numerous other articles of lasting geologic interest are included in the volume. The Digest contains three theses submitted at University of Oklahoma, a list of all theses submitted from 1951-53. All theses submitted from 1941-1952 at Tulsa University are listed. The membership of the Tulsa Geological Society and a cross reference list by company affiliation are included as another feature of the 1953 Digest.

THE OIL RECORD. Published by Petroleum Industry Projects, P. O. Box 829, B. F. Station, Washington 4. 410 pp. $8.

Operating and financial data on nearly 150 American and Canadian companies make up the greater part of this annual directory. The 1953 edition has been somewhat expanded with about 10 per cent more companies covered than last year. In addition to the alphabetically arranged company summaries, the book contains several other useful sections. These give the principal facts of interest on the country's major pipe-line systems and on the various organizations and associations in the industry. There are a number of tables comparing companies by such criteria as crude production, well completions, and refinery throughput. A seven-page introduction reviews principal developments in the industry over the last year, both in the United States and abroad.

From Washington

Role of Department of Commerce in Transportation Matters Is Being Reappraised

by Hon. Robert B. Murray, Jr.
Under Secretary of Commerce for Transportation

THE federal Government is now studying possible methods of returning basic responsibilities for transportation to private enterprise. The sale of the Federal Barge Lines removes federal competition in one field while at the same time profiting taxpayer and U. S. Treasury alike. To improve national security, a trade-in-and-build program for tanker operations has been proposed to Congress through the department's Maritime Administration. This, plus liberalized federal insurance of private loans for shipbuilding, will help to maintain an adequate supply of tankers for the National Shipping Authority and the Voluntary Defense Tanker Pool. In the aviation field, the Government's efforts have been directed toward improving efficiency and safety through installation of air-navigation aids.

THE under secretary of commerce for transportation has been assigned the responsibility of providing central leadership in the executive branch of the Government in transportation matters. Most of the Government's transportation promotional programs are centralized within the Department of Commerce under the supervision of my office.

These programs are administered by the Bureau of Public Roads, the Maritime Administration, including the National Shipping Authority, Civil Aeronautics Administration, Defense Air Transportation Administration, the Weather Bureau, and the Coast and Geodetic Survey. These agencies engage in long-range planning not only for the development of peacetime needs for transport facilities, but for their adequacy in meeting wartime requirements.

Paper presented before session on transportation, annual A.P.I. meeting, Chicago, November 9.

Transition period . . . In order to gain perspective on the general problem of the Government's relation to transportation, I should like to go back a bit over the record of the past 10 months. We were convinced at the start that, despite the fact that the federal Government has made real contributions over the years to the development of the nation's transportation system, we have been following a path which, if continued at the same pace and in the same direction, cannot but compound errors already made and lead us into new ones.

We are in a transition period characterized by the efforts of this administration to return to the American people the basic responsibilities of private enterprise in all fields of endeavor, including that of transportation. We want Government out of the transportation business except to the extent required by national-security needs and those promotional activities and reasonable regulatory processes which can be clearly justified as responsibilities of the federal Government.

With that in mind, you can appreciate the heavy pressures during this period on those agencies of government which deal so intimately with the daily affairs of American transportation. In the past 20 years many businesses have had to gear themselves into the processes of a government which has filtered into almost every field of private enterprise.

Reevaluation study . . . Our initial task, as we saw it, was to launch intensive studies to aid us in reevaluating the role of the federal Government in transportation in the light of today's conditions, and so to develop a national policy which would correct the basic defects in the administration of federal activities in this field.

But, in this "stop-and-take-a-look" process, we realized that we must sort out for action those matters which require immediate attention. So intricate and complex an affair as the Government's role in transportation, interwoven as it is into our economic life and military security, could not be completely set aside while we were going ahead with our diagnosis of what was wrong with it.

For one thing, we were faced with the task of preparing a revised budget for the present fiscal year. This administration came into office convinced that there was need for a change; particularly that the waste of taxpayers' money must be stopped; that the use of public funds in competition with private enterprise must be weeded out and eliminated; that the federal Government should not participate in any activity which could be performed as well or better by state and local governments.

We found the entire budget of the Commerce Department for the current fiscal year was $1,127,000,000. This was reduced to $846,000,000. Few realize that about 95 per cent of the department's budget is for transportation. This figure, which previously totaled $1,068,000,000, we reduced to $813,000,000, a cut of about 25 per cent. And, at the same time, our operations have been tightened and improved. We are, and we're going to continue, doing a much better job in those areas clearly marked as a federal responsibility.

A.P.I.—Transportation

Barge-lines sale . . . For many years there has been much talk and little action about selling the Federal Barge Lines. We sold this system for $9,000,000. This sale will benefit taxpayers and the U. S. Treasury, for it was made at the highest price ever offered for the lines, a price close to the amount of losses sustained by the system during government ownership from 1939 to 1952.

In addition, this property under private ownership will yield annual revenues to the Government, and has removed the Government from one area of competition with private enterprise.

In the Maritime Administration there has been a general organizational tightening-up, and progress has been made toward elimination of functions which did not seem necessary. In addition, the first 6 months of this administration have been spent in working with representatives of the shipping companies looking toward the review of the policies under which we have been operating, as set forth in the Merchant Marine Act of 1936.

Particular emphasis has been placed on a review of the operating and construction subsidies. The program which has been received from the industry committee is now under study by my office. I might add that there is a majority report and two minority reports on this most difficult subject.

Trade-in-and-Build Program

Of grave concern at high levels of Government has been the tanker situation in the United States merchant fleet. There is a need for new high-speed tankers in the active fleet from the standpoint of national-security requirements. Moreover, we have no usable tankers in the reserve fleet to meet a sudden impact of national emergency.

To correct this situation, we have proposed to Congress that the Government, through the department's Maritime Administration, offer a trade-in-and-build program to tanker operators whereby existing active tankers over certain age limits would be purchased for placement in a readily available lay-up status in the National Defense Reserve Fleet. In exchange for this, new tankers would be constructed by the operators.

Our proposal to Congress is that the current age limitation of 12 years for traded-in tankers be reduced to 10 years, thus making available a considerable number of useful ships of this type for a ready reserve. In the meantime we are working actively with the industry to accomplish what we can under existing law.

Defense tanker pool . . . Tanker owners have already established a splendid record of service in meeting defense needs. In connection with the National Shipping Authority, which has developed the structure of an ocean shipping organization for use in the event of mobilization, there has been maintained a Voluntary Defense Tanker Pool which has served the nation well in the past several years.

This group has provided tanker services under an arrangement whereby the owner of virtually every American registered tanker made available the use of his ships on a pro rata basis to help meet expensive military demands.

"In arriving at solutions and making necessary readjustments, we are not going to please everyone. This we cannot avoid; for we are obligated to formulate and effect a sound, coordinated program at least possible cost to the taxpayer."

We obtained new legislation which liberalized federal insurance of private loans for shipbuilding—a positive step forward in encouraging the entry of private money into a phase of financing heretofore almost entirely carried by the Government.

To further encourage shipbuilding activity, we have recently lifted all restrictions on the construction in American yards of ships for private account. We shall require only that such ships not trade behind the Iron Curtain and that their ownership may not be transferred without prior approval of the Maritime Administration.

We have sold the first three of the "Mariners." These are still on the ways, where they are being modified by the buyer to meet his particular needs. This sale is, I hope, the start in the integration of these ships into the privately owned merchant fleet, where they should prove particularly useful in the long-haul trades.

Home front . . . On the domestic side of our maritime policies, we are digging into the knotty problems relating to the decline of coastwise and intercoastal shipping. We are examining the economic and defense need for these services to determine what policy actions may be desirable.

An even higher safety level and better service to civil aviation at lower cost are the main objectives of the Civil Aeronautics Administration. Much progress has been made along these lines.

One important means of effecting economies while fostering a continuously higher degree of safety and efficiency is to turn over to industry and local government those functions which they can more appropriately perform. This enables the federal Government to concentrate on those areas where its responsibilities are very clear, and makes it possible to bring about a continuously higher degree of safety and efficiency.

Approximately 5,600 experts within the aviation industry are now authorized by the Civil Aeronautics Administration to carry out routine safety supervision work. The CAA staff is proceeding now with a study of legislation, regulations, and procedures to determine what additional safety tasks could be handled more efficiently by the industry.

Air and Highway Policies

The Victor Airways, a system of air-navigation aids, based on very high-frequency omnidirectional radio ranges, have been increased to 51,000 miles of primary, and to 21,000 miles of alternate airways from the 39,000 miles of primary and 19,000 miles of alternate routes on June 30, 1952.

These ultramodern very high-frequency airways offer increased accuracy and simplicity in air navigation. A total of 385 omniranges had been commissioned by September 1 to implement the new airways. These ranges provide a bearing from all directions in contrast with the four courses provided on the earlier types of low-frequency radio range.

Progress has been made during the year towards completing the initial 450 ground stations in the DME (distance-measuring equipment) system. More than 100 had been installed as of September 1. This system, as you know, enables the pilot to know at all times his distance from any given station. DME with omnirange will make bad-weather approaches possible where ILS* is not provided; will permit aircraft to bypass densely populated areas; and will increase safety in mountainous terrain.

Thorough study of the federal airport program is under way with the aid of an advisory group from outside the Government. Preliminary investigation has indicated that the program has not accomplished its intended purpose. As soon as the committee report is received by my office, it will be possible for us to indicate what we feel should be the

*Instrument-landing system.

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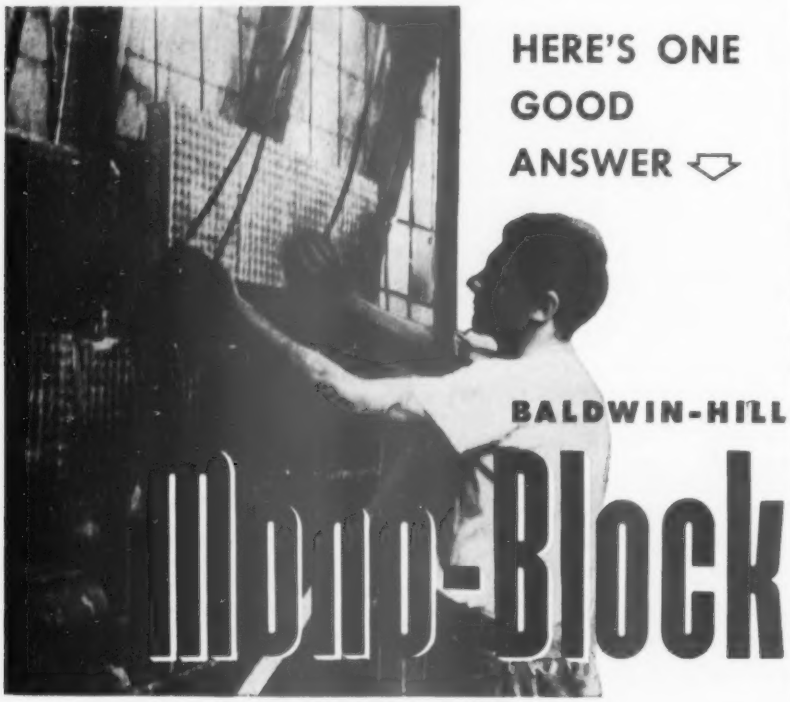

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role of the federal Government in airport financing.

In line with the responsibility of the secretary of commerce as the chief adviser within the executive branch of the Government to the President on transportation matters, our staff is currently reviewing the Government's policy in the development of the air-transportation industry. We are also well advanced in the question of charging for the use of federal airways.

At the request of the President, the Air Coordinating Committee, of which I am the chairman, has also initiated a comprehensive review of this country's aviation policy. The primary emphasis will be upon civil aviation—including, however, many important areas of interrelationship between civil and military aviation. Member-agencies of the committee will develop their comments and proposals on issues affecting their particular areas of responsibility, consulting with other agencies and using the committee's secretariat as a focal point for the exchange of information.

Many of the aviation issues to be covered have already been receiving attention in the studies now in process within the Department of Commerce.

Another important part of our transportation responsibility under intensive study is our federal highway policy. We plan to submit our recommendations on this problem to the Commission on Intergovernmental Relations and the Congress in the near future.

Sound coordination . . . All of our studies bring us face to face with some of the most far-reaching and disturbing factors lying in the path of achieving an effective, coordinated federal transportation policy. Over the years conflicts have developed between the objectives of promotional and regulatory programs—in many cases resulting in the inability or failure of the agencies charged with those responsibilities to carry out the intent of the basic statutes.

As you can see, we have tackled a wide range of transportation policy problems. In arriving at solutions and making necessary readjustments, we are not going to please everyone. This we cannot avoid; for we are obligated to formulate and effect, so far as possible, a sound, coordinated federal transportation program at the least possible cost to the taxpayer.

We cannot do this alone. To continue what I feel has been a good beginning, we must count on the understanding, support, and the active assistance of those who are closest to the problem, the providers and the users of American transportation — those who, after all, have the biggest stake of any in our joint effort.

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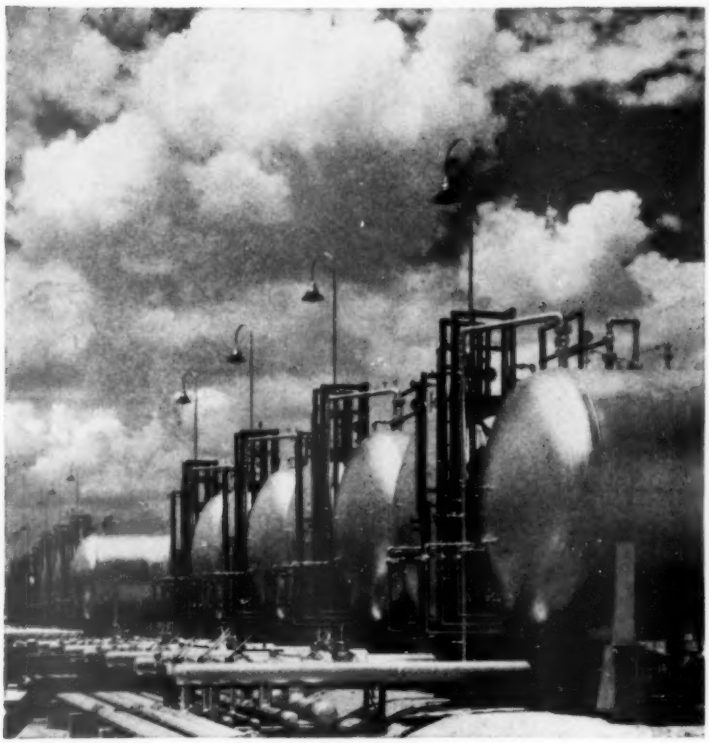

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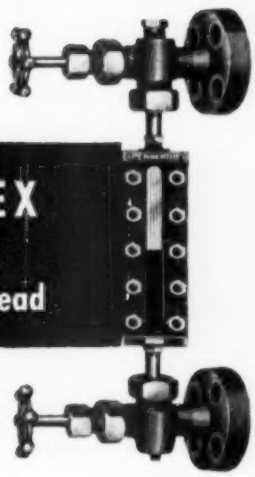

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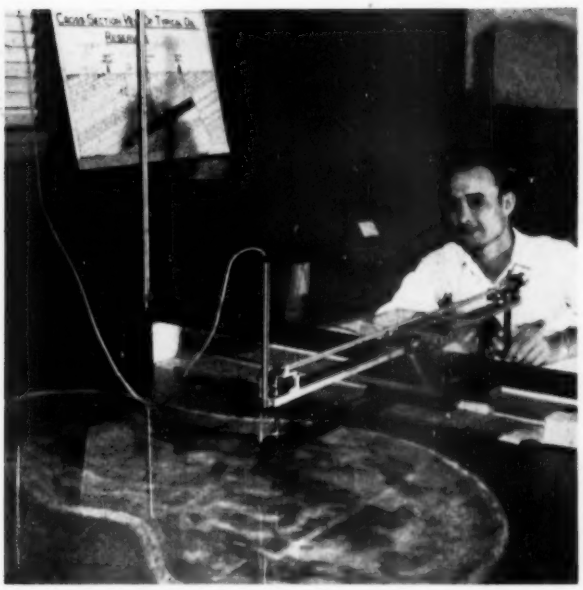
Drilling tests at Hughes Tool Co. laboratory. Rock bit has drilled into surface of test rock and is making hole. Drilling fluid, water in this case, is removing cuttings from hole as they are drilled by rock bit.



Potentiometric analyzer at field research laboratory of Socony-Vacuum Oil Co., Inc., determines the area of an oil field which can be swept out by a fluid injected at any well or wells in the reservoir.

Better Products for Greater Markets

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Twin growths of oil and automotive industries are monuments to science

by C. A. Chayne

THE importance of an industry, its success, its growth, and its value to the nation, are dependent upon the usefulness of its products. It depends upon how well those products meet the needs of the people . . . and how much their use contributes to the development, progress, and prosperity of the nation.

The fuels and lubricants supplied by the petroleum industry, used in combination with the motor vehicles produced by the automotive industry, have provided a means of transportation which has proved exceptionally useful.

Compared with the motor vehicle, no other form of transportation has been so universally adaptable to the needs of so many. On the basis of its convenience, dependability, and economy, no other form of transportation has provided such a high degree of usefulness.

Twin growth . . . In supplying these products so essential to the transportation needs of the country, the petroleum industry, and its counterpart, the automotive industry, have grown in importance . . . and in size.

The extent of this growth becomes more comprehensible when it is realized that the petroleum industry is supplying fuels and lubricants to make possible the unlimited use of more than 53 million motor vehicles in America, viz., passenger cars, trucks, and buses. The gasoline requirement alone is 3 million barrels a day!

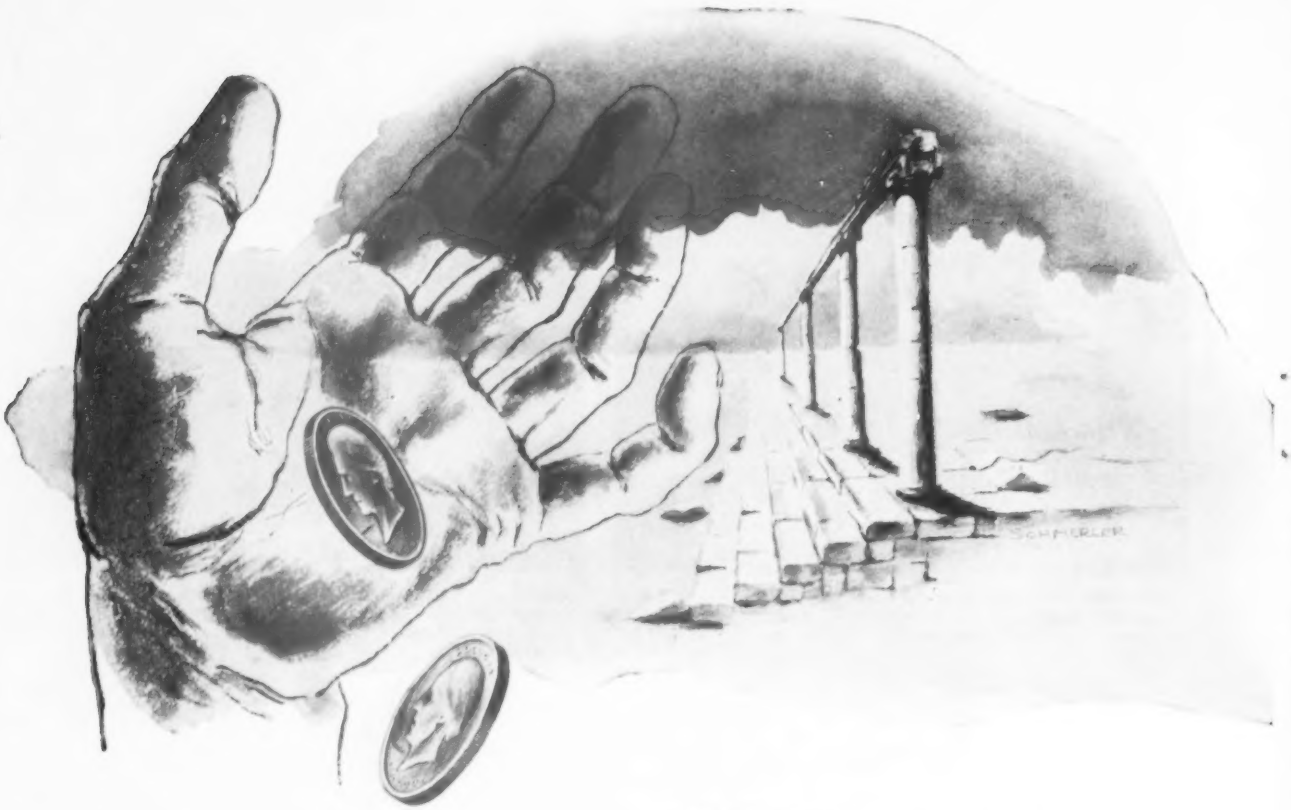
In addition to the production of fuels and lubricants for motor vehicles, the petroleum industry also is supplying the needs of military and civilian aircraft; of agricultural, industrial, and marine equipment; of locomotives and ships with diesel engines; and of fuel oil for residential and industrial heating. Fulfilling these requirements has imposed a tremendous task upon your industry. The recognition which has been accorded the petroleum industry for this accomplishment falls far short of that which is justly due.

In 1886 the then Secretary of the Interior reported that, based upon consumption at the time, our petroleum reserves would be depleted in 10 years. But ever since the petroleum industry always has been able to report a continuing 10 to 15-year reserve—although yearly consumption increases are enormous. This illustrates farsightedness on the part of extremely capable managements, and is truly an outstanding achievement.

The enormous production capacity which has been developed in both the petroleum and the automotive industries denotes progress which, when the age of these two industries is considered, is amazing. About 93 years ago there was no petroleum industry—and only 53 years ago there was no automotive industry.

Marketing . . . From the marketing angle it may be of interest that petroleum first was sold as a curative for

Author is vice president in charge of engineering, General Motors Corp., Detroit. Paper presented before session on marketing, annual A.P.I. meeting, Chicago, November 11.



what's the cost in the long run?

This important question should be foremost in the mind of every petroleum refiner when he is considering large capital investments in petroleum refining facilities.

The installation of a refining process is an important step that merits the careful consideration of every factor affecting refinery economics over a substantial period of time. Consequently, the investor should be vitally concerned with the extent of continuing

service available through the company with which he is dealing.

While the selection of a refining process, and the construction of each component are matters of extreme importance, the extent of service that the refiner can actually count upon after the process is operating should not be dismissed without very careful investigation.

Universal invites, and suggests that every petroleum refiner make an impartial comparison of the many services available through its broad and comprehensive program, and the services offered by other organizations now in the business of licensing petroleum refining processes.

Your own answer to . . . . What's The Cost In The Long Run . . . . should reveal the most economical and profitable course to follow.

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various ills. This idea was picked up from some Indians who skimmed their supply from the surface of the water in a Pennsylvania creek.

The Earlier Years

The first supply of oil in quantity was discovered in Kentucky in 1829. The drillers were sinking what they hoped would be a salt well. Much to their surprise and to the disgust of the populace, they brought in a little oil gusher. One historian wrote that they didn't know what to do with the stuff—no one knew how to put it to any good use. America then had been using tallow candles for two centuries, and this was to continue for another quarter-century before any pioneer work was done on the use of petroleum as an illuminant.

Then in 1859, near Titusville, Pa., Colonel Drake drilled his now famous oil well. That one was drilled on purpose. There was a market for kerosine for lamps which were just being invented. Other wells soon followed. Small refineries sprang up to extract the needed kerosine from the petroleum, and the petroleum industry got started.

Because of its lower boiling point, the gasoline distilled off first—barrels and barrels of it—and again . . . nobody knew what to do with the stuff. No one knew how to put it to any good use. Actually the product was naphtha, a mixture of gasoline and benzene. Because it was a good solvent for fat and grease, someone found it could be used for washing woolens without shrinking them, and the dry-cleaning business was born.

By 1900 the automotive industry got started in earnest, and by the end of that year had provided the petroleum industry with 8,000 customers. And by 1910, there was 448,000 customers. There would have been more perhaps, but it was difficult to convince people that the motor vehicle was here to stay—that the industry would have a successful future.

Skepticism was evident even on the part of the oil companies. They were supplying gasoline and lubricating oil to almost a half-million motor vehicles, including 10,000 trucks, and still delivering gasoline to their retail outlets in horse-drawn tank wagons. It was 1913 before one of the major companies finally sold its horses and bought tank trucks.

Acceptance of the passenger car was even worse. As late as 1915 some oil-company sales managers still insisted that their territory men continue to ride trains between towns, then hire a horse and buggy at a livery stable to call on their customers . . . and take orders for gasoline. Even the men in that particular company laugh about that today.

Spur of competition . . . The automotive industry has been competitive practically from the beginning. Competition has been the great incentive for advancement in our motor vehicles—their design, comfort, performance, safety, and convenience.

Comparison of a modern automobile with one of the museum pieces of yesterday brings vivid realization of the progress which has been made. To get out of your car and hand-crank one of the antiques and then get in and drive it will enable you to appreciate much better, I am sure, that the industry has come a long way in providing automobiles which are much more satisfactory.

And when you watch the performance of the newer trucks and motor coaches on the highway or take a ride in some of the late-model coaches, you are convinced that development of the commercial vehicles has kept pace.

This improvement in motor vehicles has come about through the increased knowledge, experience, and ability of the stylists, the designers, the engineers, and the production men.

Technical progress . . . In more recent years engineering progress has been achieved almost exclusively through the application of scientific knowledge and research—in other words, it has been progress through technology.

This applies particularly to engine development. This is of interest to you men in the petroleum industry. Your industry has had an important part in this progress—in developing fuels and lubricants which have helped to make possible the improved engine performance.

One of the major interests of the motor-vehicle manufacturer is to provide more miles of transportation per gallon of fuel—which is for the benefit of the user. This is of special importance from an economic standpoint, when consideration is given to the enormous quantity of fuel being consumed annually and the number of dollars being spent for it. That was the reasoning behind the development of the high-speed automotive diesel—lower operating costs through savings in fuel costs.

Octane number . . . For this same reason engineers are raising compression ratios as high as possible in engines for passenger cars and for trucks, where diesel operation is not suitable. This puts a premium evaluation on octane number.

Through the years the petroleum industry has been able to produce fuels in increasing volume with gradually increasing octane number, and—in terms of dollar purchasing power—at decreasing price. This accomplishment of the petroleum industry is one of the marvels of modern times.

Unfortunately, too few people are fully cognizant of the great economic benefit to the nation—and too few recognize the engineering and business management in the petroleum industry which made this possible.

Improved Engine Efficiency

With specific reference to our own organization, the efforts of the petroleum industry in raising octane numbers, when matched with engineering improvements in the automobile, have made it possible greatly to improve the efficiency of the automobile. We believe we have improved it 30 to 40 per cent compared with its predecessor model of 25 years ago.

This is in terms of transportation delivered per gallon, and it should be pointed out that this does not necessarily correspond with the customer's fuel-mileage record because he ordinarily takes advantage of the greatly improved performance. In some cases, however, even with the improved performance taken into account, we have been able to give him more miles per gallon.

I recall that 2 years ago C. L. McCuen, general manager of our Research Laboratories Division, presented a paper before the American Petroleum Institute in which he traced the development of one of the V-8 engines from its inception in 1915. This paper related that the 1915 car, operating at 40 m.p.h., did 9.5 miles per gallon; and that by 1951 improvements in fuels and engineering had brought the fuel economy up to 19.8 miles per gallon—an improvement of more than 100 per cent . . . and the 1951 car had greatly increased performance in every respect.

This development work continued; and now, 2 years later, the fuel economy has been further improved . . . from 19.8 miles to 23 miles per gallon at the same 40-m.p.h. speed. This additional 16 per cent increase in fuel economy was achieved through further refinements in the engine and in the engine - transmission relationship . . . without any higher octane fuel and without any sacrifice in car performance — improvement through what sometimes is called "mechanical octane number."

Mechanical octane number refers to efficiency increases developed through research on engine design and developments in power transmission, as distinguished from probable corresponding efficiency increases which could be attained by using higher octane fuel were it available.

This continuing improvement in fuel economy points out the fact that auto-

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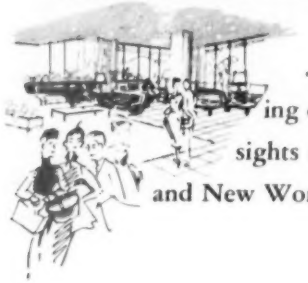

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motive engineers recognize their responsibility to utilize to the fullest advantage the fuels available to provide the maximum of economy consistent with the desired performance to which the American motorist is accustomed. We believe that still further progress in this direction is possible, and will be made.

We also are of the opinion that progress on the part of the petroleum industry in providing fuels with increasing octane number will continue. To believe otherwise would be the same as saying that fuel technologists had achieved the ultimate—that they could never make any further gain—and this we do not believe. As these technologists further improve fuels, we shall utilize them to advantage of our customers—who also are your customers.

Evolutionary advance . . . In connection with improvements in fuels and lubricants, consideration always must be given to the large number of vehicles in service, with a life expectancy of up to 15 years—or more. Each change, in either fuels or lubricants, must be evaluated in existing vehicles, as well as in new or advanced designs. Any improvement today, for example, should be compatible with the requirements of the 53 million motor vehicles now in service.

The new products also must perform better, or at least as well, in vehicles which are in operation . . . and technical trends in the development of improved products have been in this direction. For this reason advancement essentially must be of an evolutionary nature. Consideration also must be given to the enormous capital investments in refineries and processing equipment.

Additionally significant with respect to future improvements in fuels and lubricants is the technical liaison and engineering cooperation between the petroleum and automotive engineers. This factor has contributed importantly to more successful operation of automotive transportation in the past. It helped to insure more satisfactory fuels and lubricants for motor-vehicle operators in all sections of the country—in summer and winter. It also has provided a medium for exchange of important information which has led to changes in the design of vehicle components and in the petroleum products which had to be used for operation of the vehicles. There is every indication that there will be need for even more technical liaison with fuels and lubricants for the vehicles of tomorrow.

Lubrication requirements . . . Specifications for lubricants are becoming more exacting and close adherence is not only essential but imperative. The refinements in specifications are dictated by the improvements in the vehicles. Perhaps a little explanation will make this more understandable. Years ago the larger vehicles had big engines.

Although the piston displacement was high, horsepower output was relatively low . . . because, among other design characteristics, compression pressures were low. Because the engines were big and bulky, bearings sizes—especially in length—were large in proportion to their loading. Transmissions and rear axles were big, the gears large, and yet the torque transmitted was comparatively low. Consequently, even lubricants of lower average quality at the time were reasonably satisfactory.

As automotive engineering progressed and more efficient designs were developed, lubrication requirements became somewhat more exacting. Piston displacements became smaller—and compression pressures higher—in order to get more horsepower per cubic inch of piston displacement. This imposed more load on engine bearings which by then had been smaller because of the reduction in the physical sizes of the engines.

Likewise, transmissions and rear axles were redesigned to reduce weight; therefore, the gears had to be made smaller, although the amount of torque they had to transmit had been increased. This reduction in design weight is sometimes referred to in the industry as "getting rid of the iron."

Grading . . . It was at an even earlier period—when people had begun to use automobiles in winter as well as summer—that grading oil by classifications "medium" and "heavy" was no longer satisfactory. There was no way of knowing, the country over, how heavy was medium and how medium was heavy. That is what led to the establishment of definite viscosity value by S.A.E. number for more suitable engine lubrication. Then, for example, specifying S.A.E. 20 oil in the owner's manual and in lubrication data and charts for service stations, was the only way to make sure that the owner would be using the grade of oil best suited for his engine.

Even with this grading, it later became apparent that oils marketed under the S.A.E. 20 grade had a wide range in cold-starting characteristics; thus it became necessary to introduce the 10W and 20W grades to insure that low-temperature viscosity would be more satisfactorily controlled.

Service . . . More recently careful consideration has been given to additional and very important characteristics of engine oil, viz, oxidation resistance, detergency, corrosion resistance, and film strength. In order to enable the user to select the oil which best matches his type of service, the American Petroleum Institute has introduced the new service designations "ML," "MM," and "MS." The automotive industry is cooperating, and information on the new service designations already is included in 1953 car-owner manuals.

This service designation is another step forward by the petroleum industry. It provides better technical guidance for the automotive industry in making lubrication recommendations to motor-vehicle operators.

Testing . . . Automotive engineers, as most of you know, have to live with their mistakes, and that's good because it keeps them from making too many. To avoid these errors in judgment—that's perhaps a nicer way to put it—engineers do far more testing now than ever before—in the laboratory, on the proving ground, and on the road—testing to prove thoroughly their new designs. They know what the lubrication problems in the new designs are, and the types of lubricants with most desirable characteristics are recommended.

Thus the lubricants are tested along with the designs and, if satisfactory, are recommended to the purchaser of the vehicle. It should be remembered that the vehicle manufacturer has the responsibility for his vehicles—his future success depends upon their performance and their durability.

Specification Adherence

There have been occasions in the past when the petroleum industry, or at least some companies in the industry, thought that certain vehicle manufacturers were a little too tough on them for insisting that the line be closely held on certain specifications. An early example was hypoid-gear lubricant, and a more recent one is automatic transmission fluid. Holding to exacting specifications is the manufacturer's only way of insuring that his reputation and the owner's investment in the vehicle will be protected.

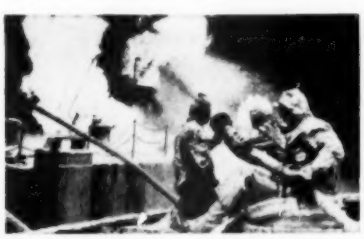
Careful adherence to characteristics which closely correspond to service requirements enables lubricant manufacturers to build and maintain their reputations for quality. It wasn't too many years ago that suspicion on the part of the motorist as to what could happen at the filling station made it necessary to merchandise engine oil in sealed cans. The motorist was a discriminating buyer then, and he still is—he continues to want his oil in sealed cans which enable him to recognize the manufacturer and the quality of the oil.

The tanker was in flames with 160,000 barrels of high octane gas aboard!

It ignited when it collided with another tanker in the Delaware River. A ten-man Navy team, from damage control training center, Naval Base, Philadelphia, under the direction of Lieutenant Commander Louis O. Lindeman, came to the rescue in the tug U.S.S. Toka. Using Rockwood fire-fighting equipment, here is what they did:

NAVY FIRE FIGHTERS using a Rockwood FFF FogFOAM Nozzle direct FOAM into the deck and holds of the burning tanker. Note blanket of FOAM on aft deck.

APPROACHING TANKER, Navy Fire Fighters discharge FogFOAM Nozzles on deck of burning tanker extinguishing fire and cooling deck permitting men to board tanker to put out fire in hold.



MEN ON TUG cool tanker deck with Rockwood FOAM discharged from Rockwood 2½" FFF FogFOAM nozzle. Note FOAM on men, protecting them from intense heat.

THE FIRE IS OUT - and 92% of the cargo saved! During fire-fighting, FOAM was also pumped into tanks below deck. Entire operation took 6 hours. Tanker in distance was cause of fire.

GET MORE FACTS about Rockwood equipment by writing for the informative, 12-page booklet "Rockwood Fire Fighting Products." Rockwood Sprinkler Company, Portable Fire Protection Division, 104 Harlow St., Worcester 5, Mass.

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A.P.I.—Oil's Technology

From the merchandising angle, the vehicle manufacturer has a decided advantage over those who market fuels and lubricants. The vehicle manufacturer makes yearly model changes which alter the appearance. But year after year, gasoline still looks like gasoline—except possibly for some variations in tinting—and still smells like gasoline. Engine oil for all these years still looks like engine oil, although the heavy-duty detergent oils actually do not look so pretty or smell so good as those which do not have all the important qualities of these oils.

Safety . . . Now another subject:—Because the automotive and petroleum industries jointly are responsible for having created motor-vehicle transportation, they, in the public interest, should share in promoting safer operation of these vehicles.

Through the years the manufacturer has cooperated closely in providing complete information on recommended fuels and lubricants. The petroleum industry has performed creditably in disseminating this information to company-operated and independent filling stations. Because of turnover in service personnel and other reasons which can be attributed to changing times, it is recommended that there be some followup to make certain that information on the vehicle manufacturer's recommendations are available in all stations for ready reference . . . and that new station personnel follow these recommendations.

The vehicles manufactured today are the safest ever built, but they still require occasional maintenance, inspection, and service. Excellent opportunity is afforded during chassis lubrication—with a minimum of extra effort by the station employe to check tires, steering linkage, parking-brake linkage, brake hoses and lines, and to report to the owner anything which might depreciate safe operation of the vehicle on the road.

When a vehicle is driven onto the lubrication rack, both the foot or service brake and the parking brake can be checked for reverse travel . . . and in not much more time than it takes to tell. If it is found that they need attention, the owner should be given a gentle word of caution.

All drivers know when brake-pedal reverse travel is running low, but some need a reminder or two before the brake system gets the needed attention. And some owners never use their parking brakes; therefore, they do not know whether it requires maintenance

attention or not. Your lubrication men will have to tell them.

One more important safety service which can be rendered to every filling-station customer who stops for gas is to check his headlights, tail lights, stop lights, and direction signals . . . to make sure they all light. It is a safety service for the customer equally as important as cleaning his windshield. The vast majority of drivers will greatly appreciate this safety check:

1. It will make every driver more safety conscious.

2. It will greatly reduce the number of vehicles operating at night with one headlight, one tail or stop light, or no tail or stop lights . . . make nighttime operation safer for everybody.

3. There's a marketing advantage for merchandise and labor sales in replacing burned-out lamps. That's a profit angle.

Better aiming of headlights is important for safer night driving. Where filling-station facilities are adequate to make headlight aiming available, this should be done. Whenever a head lamp is replaced, the headlight should be aimed, and all filling stations who sell head lamps should supply aiming service—either by the simple screen method or by an aiming machine. Correct aiming will be even more important with the new head lamps equipped with improved lower beam, which are expected to be ready for the market shortly.

It is hoped that you men in the A.P.I. Division of Marketing will give consideration to these suggestions for insuring safer operation of the cars and trucks on our streets and highways. Anything that anyone can do to reduce accidents is worthy of the effort.

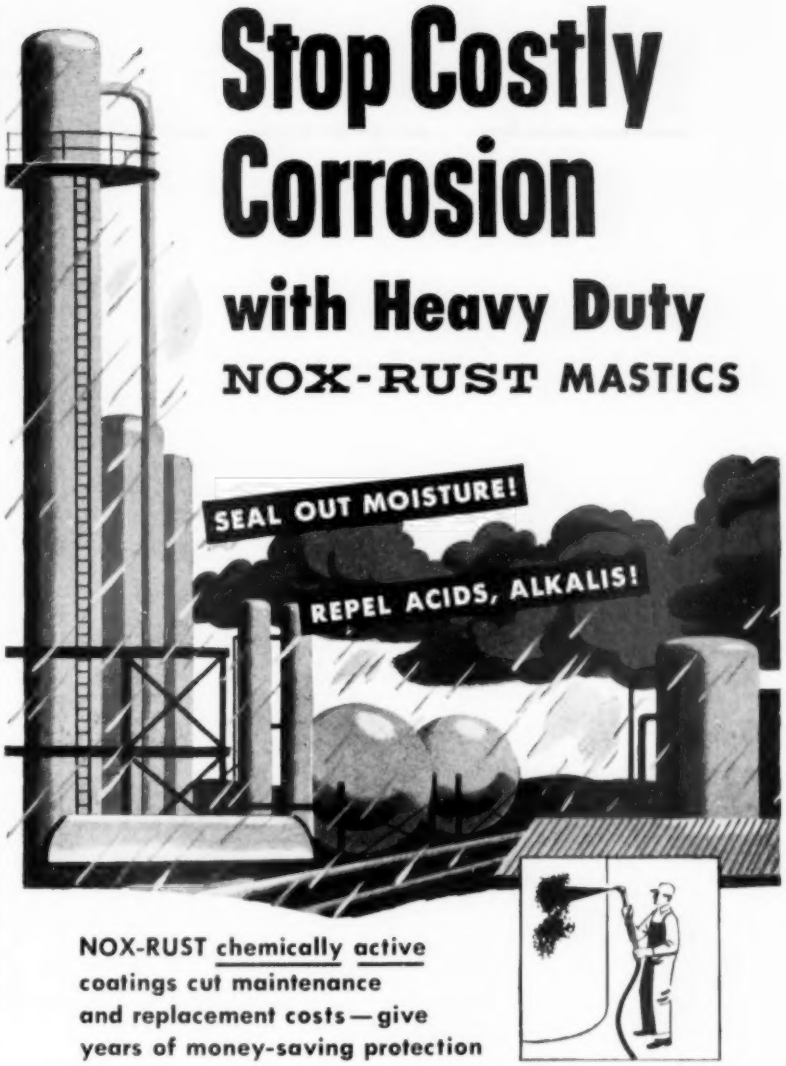
Conclusion

I am confident that the petroleum industry will make even greater strides than in the past. And I know that progress will continue in the automotive industry. However, inasmuch as both have already developed their respective arts to a high degree, the progress to be made, as I previously stated, will be progress through technology.

Phillips Sets Safety Record

BARTLESVILLE, Okla.—Employes in Phillips Petroleum Co.'s natural-gasoline department have set an all-time safety record by completing recently 2,000,000 consecutive man-hours of work without a disabling injury, according to company officials.

The 2,331 workers in the department maintain Phillips' natural-gasoline operations in Oklahoma, Texas, and New Mexico.



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NOX-RUST chemically active coatings cut maintenance and replacement costs—give years of money-saving protection

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NOX-RUST mastics are fortified with *chemically active* rust inhibitors, water repellents and plasticizers—ingredients not found in ordinary coatings which give metals only physical protection. With NOX-RUST mastics on tanks, pipes and other metal installations—indoors and out—you eliminate costly annual scraping and re-coating. As a result, sizeable savings in man hours and materials add dollars to profits. Our engineers will gladly recommend the proper NOX-RUST coating and method of application for your plant. Write today! Discover how you, too, can block corrosion and cut maintenance costs with NOX-RUST heavy duty mastics.

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☐ Send me your folder on Heavy Duty Mastics.

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In addition to political hazards, offshore operations entail expensive shore bases, costly boats for geophysical operations, expensive drilling platforms, costly transportation of men and material, expensive communication facilities, more men, and other perplexing problems.

TIDELANDS OIL: Bonanza, or Headache?

Despite the discouraging aspects of oil production on the Continental Shelf, the oil industry is gambling millions to find the oil that will be needed by this nation 10 years hence. But the right government atmosphere is necessary, and regulation limited to that necessary to protect the public interest.

by Clayton L. Orn

WHEN President Eisenhower signed on May 22, 1953, the Submerged Lands Act, and on August 7, 1953, the Outer Continental Shelf Lands Act, the Congress and the President reopened for exploration and development a potential petroleum domain one-tenth the size of the land mass of the United States. The development of this vast submerged area was begun before World War II under leases issued by the adjacent coastal states. It was stopped as to the area adjacent to California on June 23, 1947, when the Supreme Court of the United States rendered its decision in the California case,[1] and as to the areas adjacent to Louisiana and Texas on June 5, 1950, when the court rendered its decisions in the Louisiana[2] and Texas[3] cases.

Author associated with Ohio Oil Co., Houston. Paper presented before a production session, annual A.P.I. meeting, Chicago, November 10.

This great area is better known in political circles as the "Tidelands." However, scientifically speaking, it is much larger than the sea floor between high and low tide. It comprises the entire Continental Shelf adjacent to the shores of the United States. Geographically, the Continental Shelf is the undersea extension of the North American content. In geological times it was above the sea. Its slope is gradual from the coast to the edge where the dip is much steeper. The contour of the escarpment ranges in depth below the sea of from 40 fathoms to cover 100 fathoms.

The shelf adjacent to the United States contains approximately 278,000 sq. miles. The area covered by waters up to 60 ft. deep can be explored and developed for petroleum under present economic conditions, and under technological advancements made during the past 10 years. With more experience, areas covered by deeper waters may be explored.

No one knows or can make a reasonable estimate of the amount of oil and gas that will ultimately be recovered from the Continental Shelf. Fantastic guesses have been made—some as high as a trillion dollars worth. There seems to be some relation between the size of the guess, and the extent of opposition to the legislation passed by Congress and signed by the President.

Study made . . . Only one scientific study has been made of the productive capacity of the Continental Shelf. It was made by the National Petroleum Council and submitted on May 28, 1953, to the Secretary of the Interior at his request. No attempt was made to estimate the ultimate recovery of petroleum from the shelf. The report was confined to the amount of petroleum products that might be available

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at the end of 5 years if the shelf were reopened for exploration and development.

The council concluded that during the next 5 years the development will be limited to an area of 14,000 sq. miles off the coasts of Texas and Louisiana covered by waters up to 60 ft. deep, and to about 300 sq. miles off the southern coast of California covered by waters up to 50 ft. deep. It reported to the secretary that at the end of 5 years, under ideal conditions, there might be developed an availability from the Continental Shelf of about 170,000 to 200,000 bbl. daily of crude oil and natural-gas liquids, and about 600 million to 800 million cubic feet daily of natural gas.[4]

Estimates of the amount of oil and gas in place under the Continental Shelf are wholly unrealistic, unless considered in connection with the amount available on shore in times of peace and in times of war. The American public is not concerned with how much is under the shelf. It is interested in knowing how much can be produced at prices competitive with oil recovered from the uplands.

Much of the petroleum reserves may be worthless because the high cost of making them available will exceed their value. The precious metals in the oceans are enough to make every person in the world a millionaire, a cubic mile of sea water containing about $93,000,000 in gold and $8,500,000 in silver. But not everyone is a millionaire because the cost of extracting the gold and silver exceeds their value.[5]

Operating costs . . . The cost of finding and recovering a barrel of oil from the Continental Shelf will be much greater than finding and recovering a barrel of oil from the uplands, but under the forces of a free economy both barrels must be sold to the public at approximately the same price. It has been estimated that the drilling costs will be about three times greater, and the production costs about four times greater.[6]

Whether offshore oil can compete with uplands oil will depend to a great extent upon technological developments, economic conditions, and the rules and regulations promulgated by the state and federal agencies. Each lease sold by a state or by the federal Government on submerged lands must be sold in competition with leases on the uplands.

The unfavorable and burdensome provisions of some leases on the uplands, if written into offshore leases, will deter the operators in taking the risks incident to producing oil in the open sea. A spirit of cooperation, confidence, and mutual understanding between the state and federal governments and the industry will be necessary for a maximum development of the petroleum resources of the Continental Shelf.

The Continental Shelf was divided by Congress into two areas. The area constituting "lands beneath navigable waters," as that term is defined in the Submerged Lands Act,[7] was awarded to the adjacent coastal states. The remaining area, comprising the "outer Continental Shelf," as that term is defined in the Outer Continental Shelf Lands Act,[8] was set aside to the United States. The area which will be leased and regulated by the United States is approximately 10 times greater than the area awarded to the states.[9]

1. State Areas

The area of the shelf to be administered by the states under the Submerged Lands Act includes the lands covered by tide waters out to a distance of 3 geographical miles from the coast lines of the states, or to a distance of 3 marine leagues in the Gulf of Mexico in the event the boundary of any state extended 3 leagues in the Gulf of Mexico when it became a member of the union. The states will also have jurisdiction over all filled-in, made, or reclaimed lands along their coasts.

The cloud cast by the decisions in the California, Louisiana, and Texas cases on their titles to lands beneath navigable rivers within their boundaries has been removed.

Division Line

Congress did not monument the line between the areas awarded to the adjacent states, and to the United States. However, it laid down the essential elements for locating the line which can be applied by the officials of the federal and state governments and by the courts. Once the line is located, permanent reference monuments should be set along the coast.

The base line must first be located before the division line can be established. The coast line, under the Submerged Lands Act, will constitute the base line. The coast line is defined in the act as "the line of ordinary low water along that portion of the coast which is in direct contact with the open sea and the line marking the seaward limits of inland waters."

Where the coast is in direct contact with the open sea the base line will follow the line of low tide, but where the coast is broken by rivers emptying into the sea, or by bays, estuaries, inlets, and other similar indentations constituting inland waters, the base line will follow the line separating the inland waters from the open sea.

The location of the line marking the seaward limits of inland waters presents many difficult legal and engineering problems. If a dispute arises as to whether an indentation in the coast is a bay or other inland waters, or as to where the line separating inland waters from the open sea is to be located, the controversy must be settled either by the courts, or by appropriate legislation.

The unavoidable delays incident to a settlement of the issues will increase the hazards of offshore operations, and will retard the search for oil in the areas in dispute. The Supreme Court of the United States, even though it rendered its decision in the California case more than 6 years ago, has not decided some of these complex issues which have arisen along the California coast.

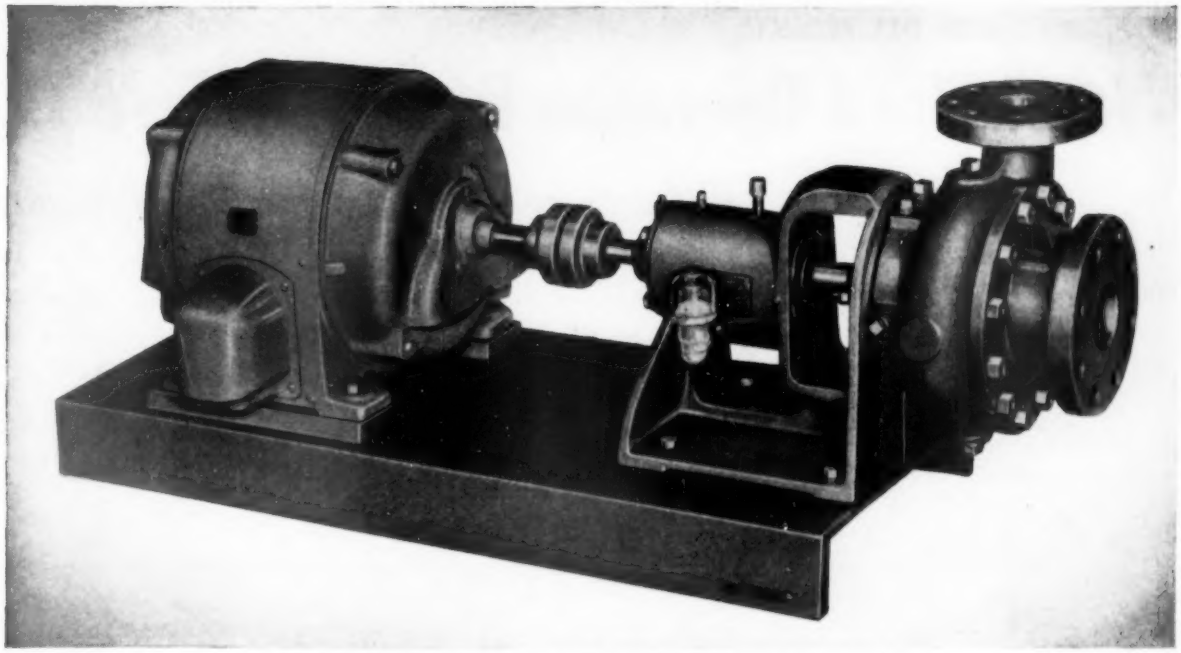
State jurisdiction . . . Once the base line has been established it then becomes necessary to determine whether jurisdiction of the state terminates at the base line, or extends 3 miles into the sea or, in the case of some of the Gulf Coast states, 3 marine leagues into the gulf, or, in the case of the Great Lakes states, to the international boundary. If a state has never extended its boundary into the sea, its jurisdiction will end at the base line until it does extend its boundary seaward 3 miles.

A Gulf Coast state whose boundary extended into the gulf 3 leagues at the time it became a member of the Union, will continue to own and be entitled to lease and manage the submerged areas 3 marine leagues from the base line. The laws of the state at the time it joined the Union must be examined to determine whether its seaward boundary is 3 miles or 3 leagues.

Texas, Louisiana, and Florida are asserting jurisdiction out to 3 leagues. When Texas was a republic it fixed its boundary as beginning "at the mouth of the Sabine River and running west along the Gulf of Mexico 3 leagues from land, to the mouth of the Rio Grande."[10]

The first constitution of Louisiana (1812) described Louisiana's boundary as follows: "Thence, bounded by the said gulf, to the place of beginning, including all islands within 3 leagues of the coast." Louisiana contends that inasmuch as it had jurisdiction over all

(Continued on page 326)



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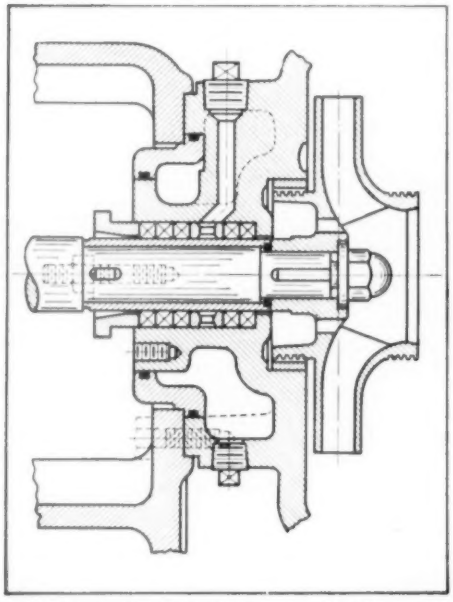

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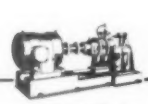

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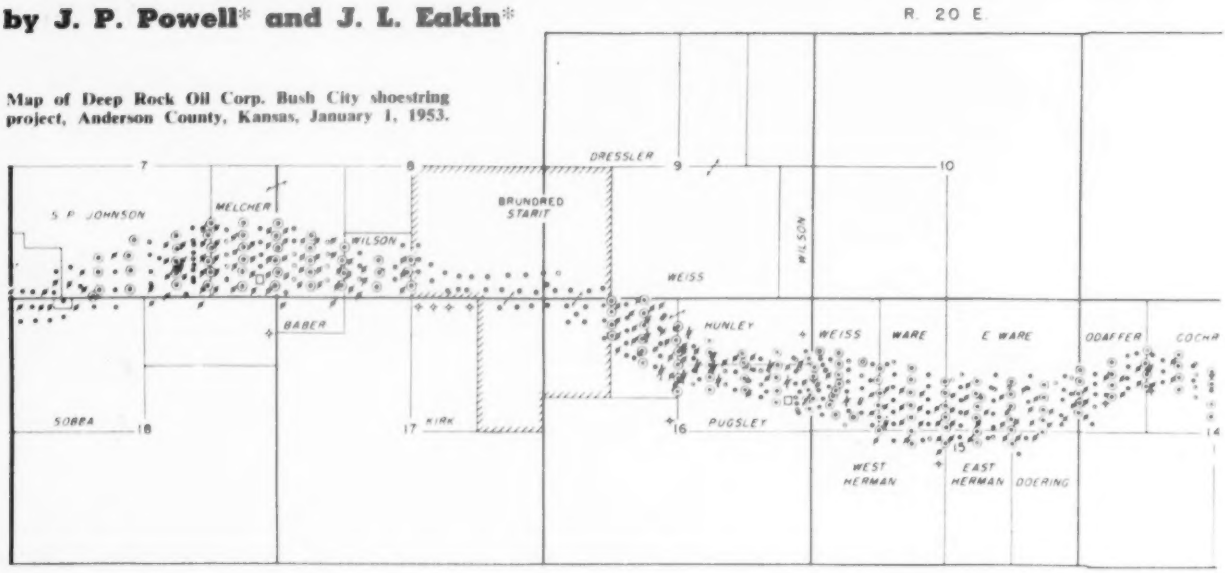


Map of Deep Rock Oil Corp. Bush City shoestring project, Anderson County, Kansas, January 1, 1953.

THE Bush City project operated by Deep Rock Oil Corp., extends approximately 9 miles along the long, narrow Bush City shoestring field of Anderson County, Kansas. The project covers over 1,475 productive acres and includes several projects begun by other oil companies as early as 1939. All of the projects now are owned or operated by Deep Rock Oil Corp.

The formation flooded is the Squirrel sand, 620 to 800 ft., and having a thickness of 20 to 30 ft. The oil ranges in gravity from 24° to 36° A.P.I.; however, the lower gravity oil is produced on leases at the western extremity of the shoestring beyond the limits of present water-flood operations.

*Petroleum engineers, U. S. Bureau of Mines, Petroleum Experiment Station, Bartlesville, Okla.; data from U.S.B.M. R.I. 4991.

Three hundred secondary-recovery personnel inspected Deep Rock's Bush City water flood during the recent Kansas-Oklahoma Water Flood Operators annual tour (see Journal issue of July 13, 1953, pp. 77-78). Core drill in foreground is completing a new well. In center is the all-electric water pressure and filtration plant, and 500-bbl. clear-water tank.

Before flooding . . . The discovery well of Bush City field was completed in 15-21s-20e, in March 1923. The field was developed rapidly, and most of the acreage was drilled by 1927. The production decline was so rapid that air injection had been begun in the older parts of the field before all the productive limits of the field had been completely defined. For this reason it is impossible to determine the volume of oil that might have been recovered by primary practices and the volume attributable to air injection. Air drives were not used intensively and many of the leases were operated under primary methods until water flooding was applied.

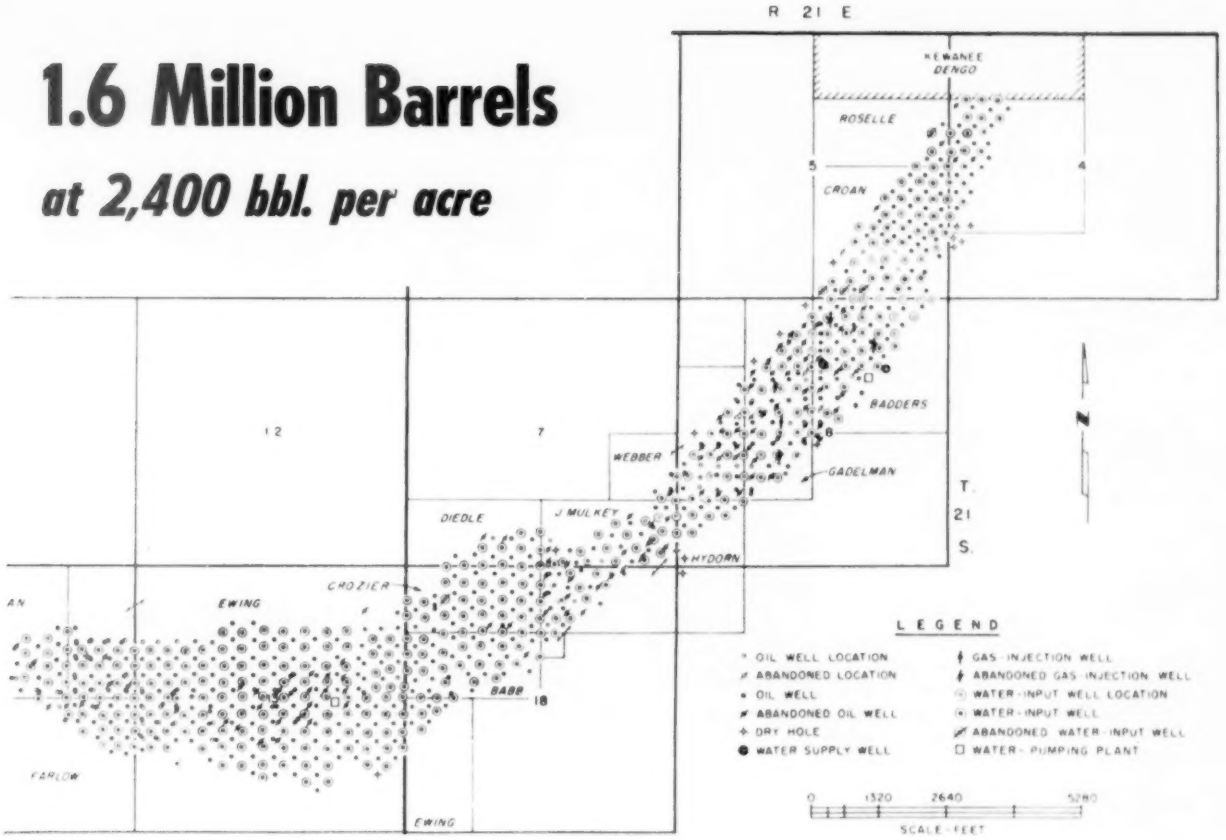
Completing Flood Wells

Various well-completion methods were used by the different operators who initiated floods in parts of what is now the Deep Rock Oil Corp. Bush City project.

Most of the water-input wells were completed with 2-in. tubing and rag packers cemented at the top of the oil sand. Some operators used cement-lined pipe, others plain steel pipe. Recently, some input wells were completed with 4-in. pipe cemented at the top of the sand. It has been the practice to shoot the input wells with 1 to 2 qt. of nitroglycerin per foot of sand.

1.6 Million Barrels

at 2,400 bbl. per acre



On one of the early floods, now included in this project, the oil wells were completed to flow by cementing 2-in. tubing on packers at the top of the oil sand. The oil-producing wells were pumped on another of the projects now included. These wells were completed with 6¼-in. casing set at the top of the sand and with tubing, rods, and pumping units installed.

Deep Rock has, especially in the western part of the project, completed most of the oil wells with 4-in. pipe cemented at the top of the sand and equipped with 2-in. tubing for pumping. This method was especially preferred in that part of the field, as the viscosity of the oil is higher and the A.P.I. gravity is lower toward the westward end of the shoestring. Most of the original oil wells in the field were plugged as water injection was begun, but a few that fell into the patterns were used. All of the new producing wells were shot with 1 to 2 qt. of nitroglycerin per foot of sand.

Flood Water

Four water-treating plants strategically located along the shoestring are being used. Each of the four plants is a separate and complete unit, although all are connected to a common distri-

This Journal photo of the Kansas-Oklahoma Water Flooders annual tour shows inspection of Deep Rock's 80,000-bbl. sedimentation pond. The water has been chemical treated before entering.

Deep Rock produces 6,500 bbl. per day of injection water supply from Arbuckle limestone at 1,400 ft., by Reda pump. The brine is shown here falling through the tray-type areator.

bution system. Each plant has a water-supply well completed in the Arbuckle limestone at an average depth of 1,400 ft. and facilities for treating and pumping the water required in that area. The OKO Plant 2 located on the Class Melcher lease is typical and will be described in detail.

OKO Plant 2 . . . Here an electric deep-well pump forces approximately 6,500 bbl. of brine per day from the well to the top of a tray-type aerator. This is to remove corrosive gases and to oxidize the dissolved iron.

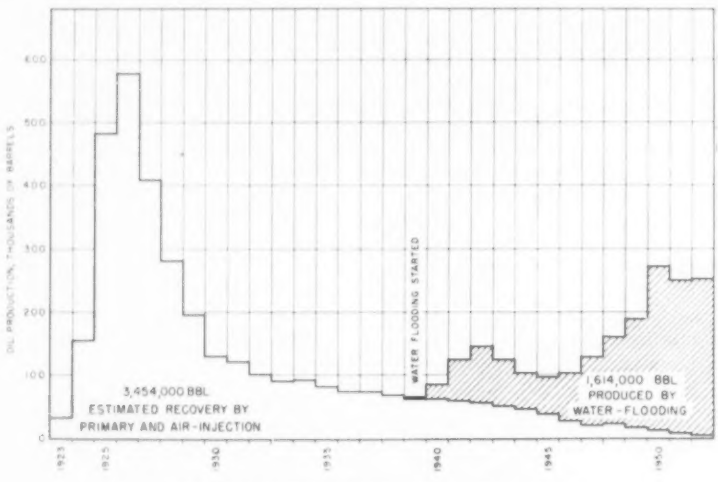
Produced brine is mixed with the water from the supply well at the top of the aerator. The water falls from the aerator into a pond having a capacity of 4,000 bbl., in which products of oxidation settle before the water enters a cement trough. In the trough a solution of lime and ferric sulfate is added as the water flows to a second pond having a capacity of 80,000 bbl. The second pond contains baffles to prevent the water from channeling directly to the outlet, and to provide time for the chemical reactions to go to completion and for the settling of precipitates. The brine is pumped from the pond through a 6 by 6-ft. pressure filter containing crushed anthracite as a filter medium and thence into a 500-bbl. clear-water tank.

A horizontal triplex pump, equipped with porcelain plungers and driven by a 50-hp. electric motor, pumps water from the clear-water tank into the distribution system at a pressure of 535 psi. The back-wash pump for the filter is a 4 by 4-in. centrifugal pump driven by a 5-hp. electric motor.

Approximately 1 gal. of corrosion inhibitor is injected into the annulus between the casing and the tubing of the brine supply well daily. No special additives are used in the injected water.

Chemical treatment.—As the supply water leaves the aerator, a solution of lime and ferric sulfate is added. From the treating building at right the water flows through a cement trough (center foreground) to the 80,000-bbl. sedimentation pond.

Oil treaters and bank batteries.—From its Bush City project, Deep Rock has produced 1,614,-066 bbl. of oil (to 1-1-53); the cumulative water injection to oil produced ratio is 12.



Production history of Deep Rock's Bush City project.

SUMMARY OF OPERATIONS

(Deep Rock Oil Corp., Bush City project)

Location, from	12-21s-19e to 4-21s-21e
Sand flooded	Squirrel
Top of sand, ft.	620 to 800
Sand thickness, ft.	20 to 30
Productive area, acres	1,475
Area flooded, acres	1,300
Well pattern—five-spot, ft.	330 by 330
Kind of water	Brine
Type of system	Open
First increase	Oct. 1939
Gravity, °A.P.I.	24 to 36

SUMMARY OF WATER-FLOOD PERFORMANCE

Date—	Acres flooded	Input wells	Oil wells	Cum. oil-prod. (bbl. per acre)	Cum. water-inj. oil-produced ratio
January 1, 1940	80	8	25	43	36
January 1, 1941	90	26	29	290	15
January 1, 1942	109	31	38	827	11
January 1, 1943	150	39	50	1,196	11
January 1, 1944	182	55	60	1,389	11
January 1, 1945	206	67	89	1,507	11
January 1, 1946	242	85	99	1,521	11
January 1, 1947	302	115	124	1,471	11
January 1, 1948	322	125	158	1,713	11
January 1, 1949	408	162	177	1,691	10
January 1, 1950	750	349	383	1,151	10
January 1, 1951	916	377	425	1,226	10
January 1, 1952	970	432	423	1,409	11
January 1, 1953	1,300	503	532	1,242	12

Results of Water Flooding

More than 1,600,000 bbl. of oil has been recovered from the Deep Rock leases at Bush City to January 1, 1953, by water flooding. Many older leases in the flood have passed their peak rate

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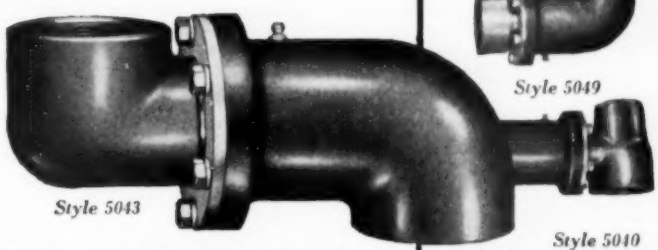

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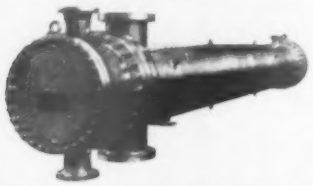
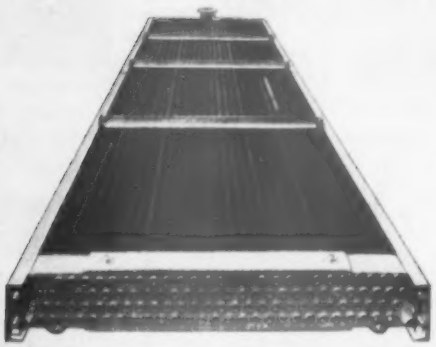
G-Fin Storage Tank Oil Heater, available in designs for installation partly within or entirely outside of tank.



G-Fin Heat Exchanger, for cooling large quantities of gases, or for cooling or heating viscous liquids.

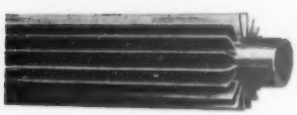
K-Fin Tar-Heated Reboiler, for separation of liquids which do not have close distillation curves.

K-Fin Air and Gas Cooler and Heater, widely used to cool air or hydrogen from generator windings.



K-Fin Atmospheric Section, used in the Fin-Fan Air-Cooled Exchanger, many hundreds of which are in use all over the world.

Headquarters for Finned Tube Units



G-Fin Element with longitudinal fins

K-Fin Element with helical fins

More than 30 years ago, G-R originated the first finned heat exchanger element that would withstand high temperatures and pressures.

G-R has, since then, developed many additional designs of finned elements and many different types of finned tube units, each for a specific range of services.

Today, the G-R line of finned-tube apparatus covers every heat transfer duty in the petro-chemical industries. These units include vapor condensers, heaters, coolers, and heat exchangers . . . for light, heavy, viscous and dirty liquids, vapors and gases . . . for small and large capacities at low and high temperatures and pressures.

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PIONEERS IN HEAT TRANSFER APPARATUS

of oil production; however, flow tests and other field work indicate a possibility that considerable additional oil may be obtained through remedial work on the oil wells.

Several older oil wells are almost completely filled with small white pellets approximately the size of B-B shot. Exxamination and analysis indicate these pellets are concentric layers of barium and strontium sulfate, formed on grains of sand as nuclei. The sulfates apparently were deposited on sand grains in the open holes, and the layers were polished by a rolling action created by the flow of fluids. Enough sulfate deposits were found in several wells to impede the rate of flow and in a few instances to stop flow.

The deposition of barium and strontium sulfates was noticed in wells on a flood in Franklin County. The wells on this project are pumped, so the deposition occurred on and in the tubing, increasing the number of pulling jobs and eventually coating the tubing to such an extent that it was necessary to replace it.

The area under flood in this Deep Rock project was developed gradually from 1939 to 1947, when 322 acres was under flood. At that time the cumulative oil recovery by water flooding was 1,712 bbl. per acre, equivalent to a water-injected oil-produced ratio of 11:1.

During the past 5 years, however, the project was expanded over fourfold. As a result of the increased acreage involved, the cumulative oil recovery was reduced to 1,242 bbl. of oil per acre as of January 1, 1953. At that time the project covered 1,300 acres with a total of 1,035 active wells. A total of 18,753,040 bbl. of water had been injected to produce 1,614,066 bbl. of oil, or a water-injected oil-produced ratio of approximately 12:1. It is estimated that an additional 1½ million barrels of oil will be recovered by water flooding.

"Just because I said to get everything oiled is no excuse!"

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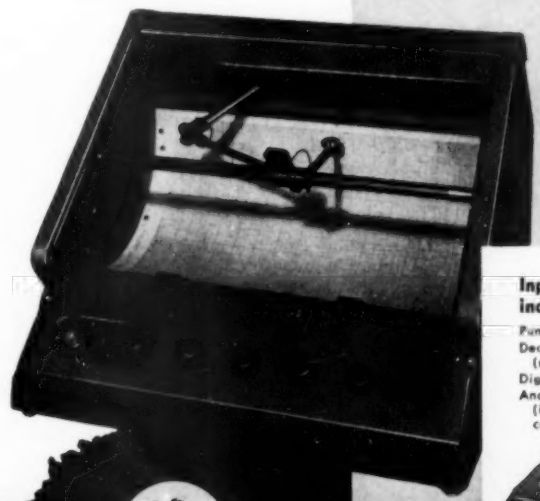
For discrete point plotting or continuous-trace recordings on standard graph paper, Librascope produces a two coordinate portable recording instrument called the X-Y Plotter and Recorder. This unit is noteworthy for rapidity and accuracy of performance and is applicable to a great variety of data reduction operations.



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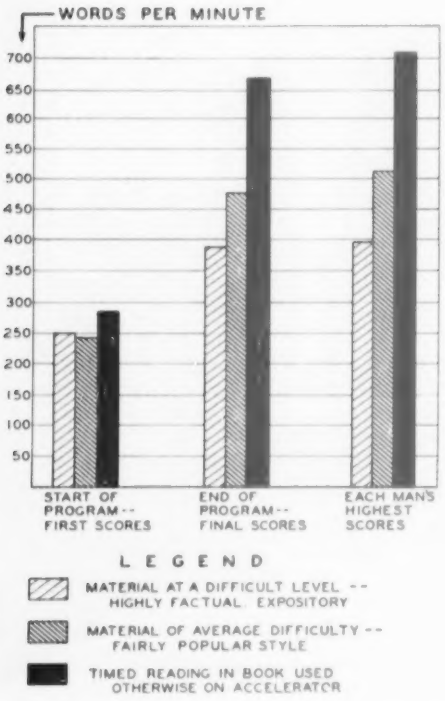
Part of one group of seven key executives trained for Standard-Vacuum Oil Co. by the Reading Laboratory. In foreground is the Horry F. Prioleau, Standard-Vacuum president, working with the tachistoscopic trainer. Using accelerators in background are R. J. Worssam (at right), area consultant; A. H. Hellwig, comptroller. The laboratory counselor is standing, and to his right is L. J. Barnett, East Africa consultant, taking a timed reading exercise.

Oil Executives Double Reading Rates by Modern Training



Here's the Score On Improvement

The graph reports over-all gains for the participants in the reading-improvement program at Standard-Vacuum Oil Co., Inc. The gains have been broken down according to difficulty levels of the material read. When compared with "final scores," the "highest scores" show very well that the ranges of speed established by the three-quarter point in the program were maintained and consolidated. All gains in the reading-improvement program were made while maintaining or improving comprehension. Note also that the speeds for the various levels were much nearer each other when the program began than when it ended. Such greater flexibility of approach to material of different difficulty levels is one of the important time-saving aspects of the program.

by Horace Judson*

FOR more than 200 top executives of two important oil companies, training in the methods of faster reading has resulted in an over-all **doubling** of reading rates.

The May 18 issue of The Oil and Gas Journal reported on the methods in use for development of executive reading abilities, and on the concepts and physiological facts underlying those methods. Just at the time that article appeared, two oil companies completed training of groups of their management personnel in the techniques of faster, more efficient reading. In the middle of May, Standard-Vacuum Oil Co. completed a pilot program including 25 key executives. At about the same time, the Reading Laboratory's counselor who had been in Venezuela for 6 months, training at several locations for Mene Grande Oil Co. (Gulf Oil Corp.'s South American subsidiary), returned with the trunks of training equipment and books which were required for work with about 200 executives. Both of these companies have approved the use of the results obtained with them, for this report on what reading training has actually accomplished in the oil business.

Back in the spring of 1952, Dr. Lawrence F. Hawkins, one of the Reading Laboratory counselors, first went down to Caracas for Mene Grande's pilot program. Training was scheduled for four groups of seven men each, all from top executive ranks, who were to evaluate the worth of the program to them. Results in Caracas were so successful—just under a doubling of reading rates, on average—that we were asked to return to Venezuela in the fall of '52 for 6 months of training in Cabimas, San Tome, and Maracaibo. In all, just under 200 of Mene Grande's management, supervisory, and technical personnel received training. And for those who completed the full program, results included more than a doubling of reading rates, taking all levels of difficulty and all men together.

The training methods which achieve such results are based on one simple fact: although reading a line of print feels like a smooth, steady movement of the eyes across the line, actually **reading is done in a series of short pauses on the line.** It is during these pauses that you, the reader, see. Most untrained readers make one of these pauses, or fixations, for **every word** on the line, although now and then the faster untrained readers will toss in a short word with the longer word

(Please turn to page 311)

*Assistant to director, The Reading Laboratory, 500 Fifth Avenue, New York.

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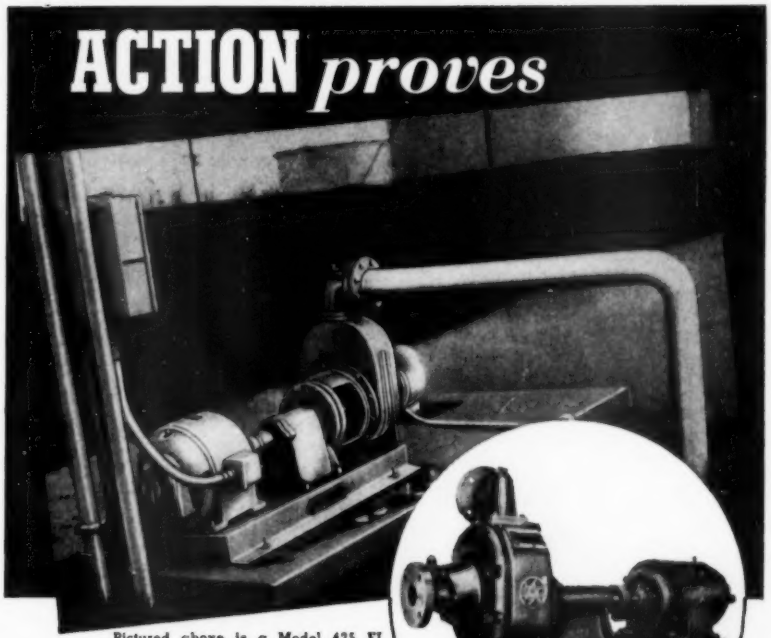
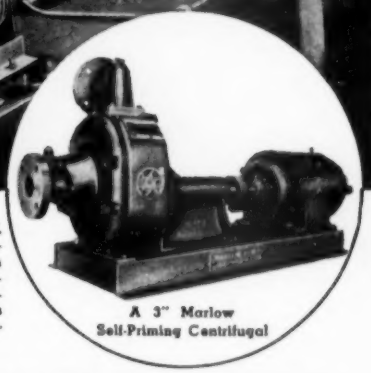
KENNAMETAL
PUTS AN END TO DOWN-THE-HOLE CHECK VALVE TROUBLE

ACTION *proves*



Pictured above is a Model 425 EL Marlow Pump funnelling surface drainage water to outside storm ditches on tank farm of major oil pipeline company on Gulf Coast of Texas. Accompanying this photo was the foreman's expressive testimonial — "These Marlows are doing a splendid job!



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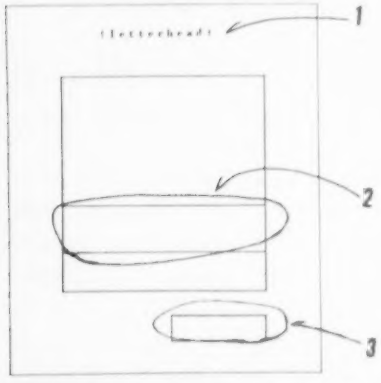
That is, almost all writing has some sections which develop the ideas in detail and other parts which are summaries. To preread, find the summary sections and read them carefully before going through the whole thing. Here is where you will usually find these summary sections:

Business letter	Newspaper article	Article in journal, magazine	Book (nonfiction)
1. Letterhead	Headline	Title and subtitle	Table of contents
2. Two-thirds point in body of letter	First paragraphs	First **and last** paragraphs	Preface, introduction
3. Signature	Read on only if you need the added details later on in the article	Glance through body of article to see how author divides his subject and how he gets from start to finish	Read first **and last** chapters going through the steps for prereading journal articles
4.			Treat each new chapter with the same prereading steps as an article

You will normally find summarizing material in these places. Sometimes there will be summaries in other spots as well: in a technical book, for instance, each section of several chapters may be introduced by a summarizing chapter. Your reading of the table of contents would let you know when such a situation exists, and you would then read these intermediate summarizing sections also.

Fig. 1 is a diagram of where to look

1, 2, 3 . . . AND A BUSINESS LETTER!



At this point you know enough about it to delegate it to the right man. If you must handle it yourself, you have identified its source and content, and can read it at full speed. Note: Internal memoranda are not written with the same form as a business letter. But you can adjust this 1, 2, 3, formula to the form used in your organization for internal correspondence.

to get the gist of the usual business letter. A writer who does not follow the usual fairly dry business format may fool you by getting to the point in the very first sentence, but you will notice this immediately.

For practice with trade-journal material, try on this article, and on all the others you read in this issue of The Oil and Gas Journal, the steps listed in the prereading table above for articles or book chapters. Note that the **last** paragraphs as well as the first are to be read before you read the whole article. The time and trouble this takes will be repaid by better understanding and greater speed when you read the whole article.

Careful reading of all summary sections, as listed above, will give you a framework into which you can later fit the details of the piece, without confusion and with much less danger of misunderstanding or forgetting. Details will stay in the perspective you get for them by reading the summaries. And therefore besides insuring high comprehension, prereading allows you to reach greater speeds in straight reading, for it gives you the main ideas of even unfamiliar material.

(Reminder: are you reading at your **top comfortable pace** now?)

Step 2—Question the Main Ideas

The second in the series of steps increases your comprehension selectively: the reading tool we are about to describe gets at the main points of the author in terms of their **importance for you.** At the same time this technique is the most important single aid to concentration.

After the prereading which was your first step, you will normally have enough knowledge of the letter, memo, report, article, or book to state to yourself what seems to be the author's main concerns. "Why did he write the articles What problem is he solving? What seems to be the main conclusion the author is working towards?" And then ask the question, "What do I need from this article? What questions will it answer for me?"

State the answers clearly to yourself. First state to yourself what seems to be the author's main points. Second, state to yourself as precisely as possible the information you expect your reading to give you.

Questioning the main points to yourself in this way aids reading speed: you will be reading to find the material you need and not wasting time with parts of the same piece of writing which are not useful to you. It helps comprehension by emphasizing main points and details which are important to you. It builds your confidence in reading at your top pace by giving you a definite measurement of how well you comprehend: if you get the answers to your questions, or are not reading too fast.

Most importantly, the question method gets your active interest centered on material you are about to read. Concentration is almost entirely a matter of balance of interests. If you are faced with concentration difficulty in reading which normally has great interest, think for a minute about other things on your mind. A big conference or special report coming up? Your son break his arm? Other things can drive out of your mind any interest in the material to be read, when the other subjects temporarily have greater interest for you. A technique which will bring your interest back to the page in front of you is required for better concentration on important or routine material—the difference between the two types of material, as far as concentration is the problem, lies merely in the greater ease with which most people can be distracted from reading material of routine sorts. For comprehension, full use of speed, and above all for con-

CHECK LIST FOR BETTER READING

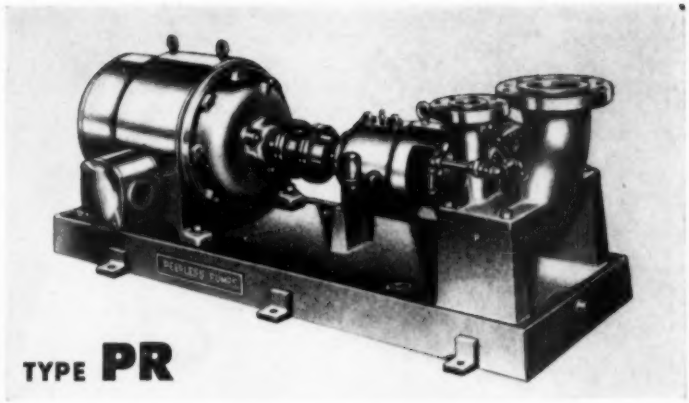
1. **Preread . . .** Look for summary material.
   Determine how the pieces of an article or book fit together.
2. **Question the main ideas . . .** What seem to be the author's main points?
   What information do you need from the piece?
3. **Differentiate** your reading rate according to your purpose.
   And use your **top comfortable pace** for that purpose.
4. **Practice speed** once or twice each week by double reading:
   Once through for **speed** (push!).
   A second reading to check **comprehension.**

designs

TO SUIT THE APPLICATION

VERTICAL

HORIZONTAL



TYPE **PR**

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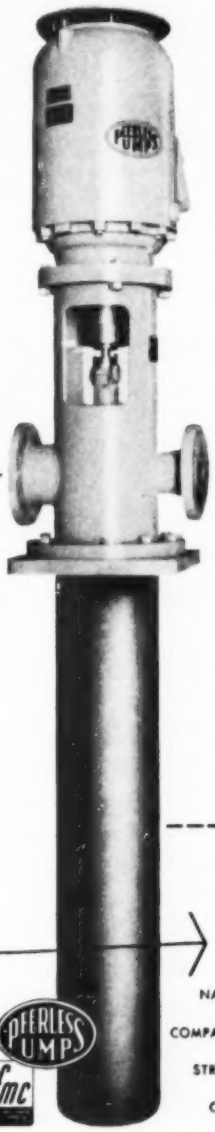

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next to it. Such word-by-word reading limits speed: most of the men trained for Mene Grande and for Standard-Vacuum were found to be word-by-word readers in movie-film records of their eye movements, taken before training. And correlating with this result, the group averages for speed, before training, were found to be quite near the national executive average of 230-250 words per minute—this was true for both companies.

In training for greater reading speeds, two mechanical aids are used, both of a size to sit on top of a desk. One of these machines, called the accelerator, has a curtain which descends over the page of any book placed in the device. As the curtain comes down, the reader is forced to stay ahead of it. The speed of the curtain can be set at anything from 50 words per minute to well over a thousand words per minute, and by stepping it up from session to session of the training program, the reader is pushed into a steadily smoother, faster rate.

Speed Comes From Fewer Jumps

Most of the trainee's new speed comes through learning to make fewer eye fixations on each line. To let him do this without missing details he needs for good comprehension, another machine is used. Called the flashmeter, or tachistoscope, this additional device flashes, for very brief time intervals, numbers and phrases of gradually increased length. In this way the reader is trained to take in more each time his eyes pause on the line. Thus, he can respond to the push of the accelerator curtain **without losing comprehension,** for he has learned to make fewer stops on the line of print, at the same time he has learned to see all the words he needs to understand the material.

His actual application of these techniques to normal reading is measured with a series of timed reading exercises, "measured miles" of typical reading on several levels of difficulty. Each of these exercises includes a rigid comprehension check. They are administered at the preliminary survey of reading skills, throughout training, and again at the close of training to provide a continual measure of progress. (Administered still again after several months have passed, they have in many cases been used to demonstrate the extremely durable results achieved through training.) From these measurements of reading rates, administered without the push of the mechanical aids, are taken the figures for improvement cited in this article.

The excellent results achieved with Mene Grande are not exceptional. The Reading Laboratory has duplicated its New York training setup on the premises of many companies, to provide the carefully individualized training which most fully develops speed, as well as training in the methods for comprehension, reading economy, and concentration, which must be fully developed in order to get maximum use of the new speeds **on the job,** behind the desk where it counts.

Standard-Vacuum brought us in at the beginning of spring this year. Training was for a pilot program, four groups of not more than seven men each. With each group scheduled 2 days a week, the first group in the morning included the president of the company, Horry F. Prioleau, and a member of the board of directors, Edward N. Leibacher. You will see the sort of thing that occurs in reading training, from the chart of Standard-Vacuum's results which is with this article. The three difficulty levels of timed reading exercises are included, with first, last, and highest scores averaged for all the men who completed more than two-thirds of the program. Computed on a slightly different basis from first, last, and highest scores, in order to state what was reached as a midpoint of the new reading ranges, Standard-Vacum had an index of improvement of 105.7 per cent—all men, all levels of difficulty.

Results with Standard-Vacuum were very similar to those obtained with Mene Grande. For both groups—a total of well over 200 men—the essential statement of results is: "A very solid doubling of reading rates, with maintenance or **increase** of comprehension." And these results are durable. Although it is still too early for retesting of the Standard-Vacuum group to be significant, results of retest with many individuals and company groups show that with the need to **use** the new reading habits, there is no danger of slipping back to the old slow speeds for those participants who have completed enough of the program so that the "over learning" is effective which has been built into the program.

During the initial skills survey the 22 men who completed 10 or more sessions of the Standard-Vacuum program reported a total of **337** hours of business reading each week. The improvement made at Standard-Vacuum amounts to at least 165 hours each week to be spent on additional reading or on other activities. That's the equivalent of four new employes at the average salary of these men, with the average experience of these men, and with **the new effort distributed over all the key positions included in the Standard-Vacuum group,** rather than concentrated behind four new desks.

How YOU Can Improve YOUR Reading

THE most important steps to better comprehension and concentration form a check list of items. You may find that the never-ending visits of the mail boy have forced you to develop for yourself some of the items in the check list. Others will be new to you. We would strongly suggest that you use **all** the suggested techniques on every piece of reading you do for the next several weeks. The methods form an integrated series of steps, and you will get maximum gains in speed and in mastery of the material only by using them all together.

For the next few weeks, therefore, you may find that using these methods takes a little more time than you now require for reading. But if at the same time you push your reading speed to your **top comfortable pace** on everything that you read, by the end of the learning period you should actually be taking **less** time to **get far more** than at present.

So start right now. Get settled comfortably, but not too much so. (Just sitting in an attitude of attention will help amazingly in many cases.) For the rest of this article, read at your very top comfortable pace. Really push!

Step 1—Preread

Prereading is designed to give you the general structure and subject matter of the piece you are about to start. At the same time, prereading will let you sample the difficulty of the piece. Prereading is without doubt the most important single tool for increasing comprehension for anyone who does about as well as the average untrained reader.

Prereading takes advantage of the way almost all writing is organized.

(Please turn to page 308)

vital as the second step in the reading process.

Step 3—Differentiate

According to your purpose in reading, and according to the difficulty of the material itself, the next step is to differentiate your reading rate. Most people tend to slow down their reading when it is extremely important for them to grasp all the details. Otherwise, the usual untrained reader attacks all reading without very much flexibility of speed. Neither the slowing down nor the rigid approach are necessary or desirable. You **will** need to slow down for technical or other material which is on a difficult level. But it is not necessary to slow down to maximize comprehension of material of the sort you normally read. Instead, read even the most important material at a comfortably fast pace—with the other techniques suggested in this article you'll get the comprehension you need. And for material which is less important, **speed up.** The more general your comprehension goal is, the faster you should read. Most reading in the familiar flow of job situations should be done at your very top **comfortable** pace. Some reading where you are not directly concerned (perhaps a report which is passed to you from another section of your firm merely "for your information") should be read at a speed **above** your comfortable level. But this brings us to—

Step 4—Practice Speed

Once or twice each week, pick out some difficult reading from the in-box. Choose several pages, and choose a time when you have a few extra minutes to spend on reading practice. Put the article through the first two steps that we have described above. Then read it **twice.** Push your speed as fast as you can get it, the first time. Take the material at a pace considerably faster than you feel is safe or comfortable. Then read it over a second time more slowly, to check details you may have missed.

Try this same technique at home occasionally, with any general reading. You may not get perfect comprehension the first time or two, but we are sure that you will find the second reading to be less and less necessary.

The steps above are a selection of some of the most important techniques used by the Reading Laboratory, along with mechanical aids for speed improvement, in the training program evolved for use with businessmen and executives, and described in a previous article ("Executives Get Basic Training—Reading for Profit," in the May 18, 1953, issue). At the Reading Laboratory these methods are used in combination with skimming techniques, analysis of different paragraph structures, key words and transitional words, and detailed treatment of exactly what occurs in various sorts of reading, both physically and psychologically. In this article, the techniques listed form an integrated series for self-help. Try them conscientiously. And to help you keep the steps in mind, there is shown a sheet which we would suggest you keep on your desk or in your wallet.

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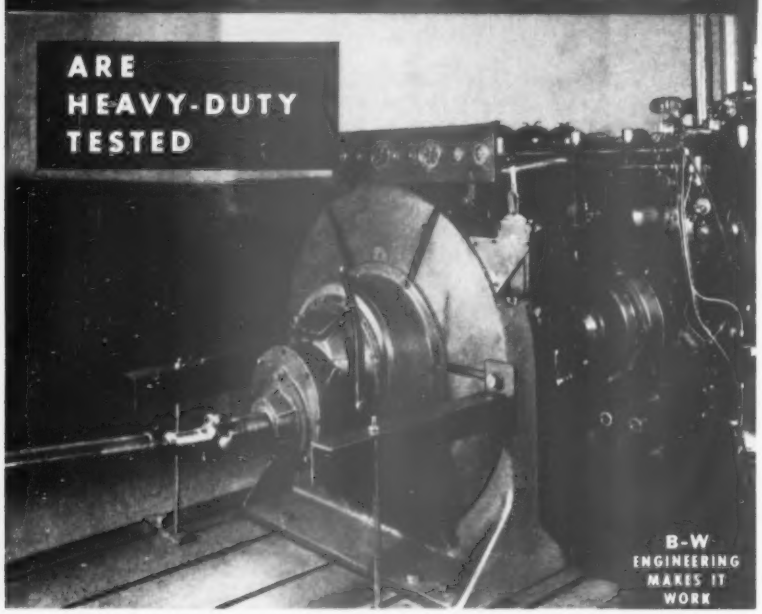

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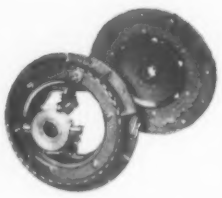


B-W PRODUCTION MAKES IT AVAILABLE

ROCKFORD CLUTCH DIVISION BORG-WARNER
1305 Eighteenth Avenue, Rockford, Illinois, U. S. A.

REFINERY PROCESS NEWS

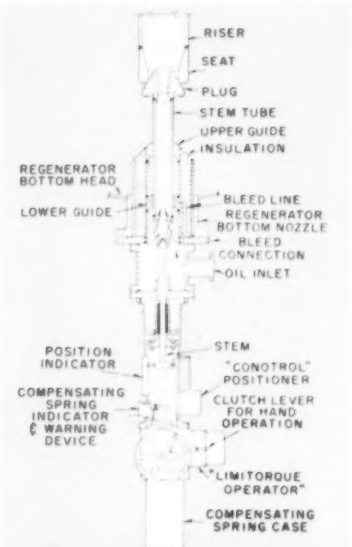
PUBLISHED BY REFINERY PROCESS DIVISION, THE M. W. KELLOGG COMPANY NOVEMBER 1953

Patented Plug Valve Key to Orthoflow's Operating Ease

Unique mechanical features of the Orthoflow Fluid catalytic cracker are the plug valves which replace the more conventional slide valves. Designed and patented by Kellogg, they might well be termed the key to the decreased investment, easy operation and low maintenance cost of the Orthoflow.

Not only do they make feasible the elimination of expansion joints in certain of the Orthoflow units, but also they are much more easily maintained than slide valves. Actually, the new valves make possible the basic advantage of the Orthoflow: Straight-line flow of catalyst with its concomitant reduction in erosion.

The plug valves are so arranged that they can be unflanged, lowered from the bottom head and taken to a shop for maintenance while the rest of the unit is being inspected and repaired.



PLUG VALVE FOR REGENERATED CATALYST

Although the plug of the valve is subjected to the same type of erosion that is encountered in slide valves, and its rebuilding or replacement must be expected after about a year of service, the valve seat and the straight catalyst lines themselves have proven remarkably free of erosion difficulties. Only minor repairs have so far been necessary.

All these factors, coupled with the ease of shut down and start up, make the Orthoflow design a highly attractive one.

Combination Processing Can Reduce Total Investment Costs by More Than 20%

Recently completed economic studies by Kellogg comparing combination refining with conventional sequence-type unit-processing show the remarkable savings in investment and operating costs as well as the improved yields that may be obtained through the integration of a petroleum refinery.

Today it is possible by skillful integration not only to cut the cost of the processing equipment from five to 15% but also to reduce the cost of offsite facilities by as much as 25%. The overall effect results in the possibility of erecting complete new combination refineries at perhaps 20% less than the cost of building comparable capacity in individual process units.

Important savings also result from reduced operating costs such as labor, fuel, power, steam, water, and maintenance.

Although there are savings in utilities—particularly through the conservation of heat due to the virtual elimination of intermediate storage—and in maintenance charges, the largest single reduction in direct operating costs for combination units results from smaller labor requirements. Total operating personnel needs may be slashed by as much as 30%.

In addition to the savings already mentioned, the combination plant has a further advantage in improved yields due to a reduction in evaporation and other losses. An increase in gasoline yield of about one percent may be expected in a combination unit—an important source of increased earnings and quicker payout. (Shown above is a typical modern combination catalytic refinery.)

NOTE: For more extensive study of combination refining and its advantages send for KELLOGGRAM NO. 1, 1953 which compares the economics of 10, 20 and 40,000 BPD combination units with conventional plants of equal capacities.

SEE REVERSE SIDE

CONTINUED FROM PRECEDING PAGE

Operating Data Reveals Kellogg Reactor Efficiency

Recent operating data from two relatively new sulfuric acid alkylation plants clearly reveal that the Kellogg cascade reactor is highly effective in producing excellent yields of high-octane alkylate with a minimum consumption of acid.

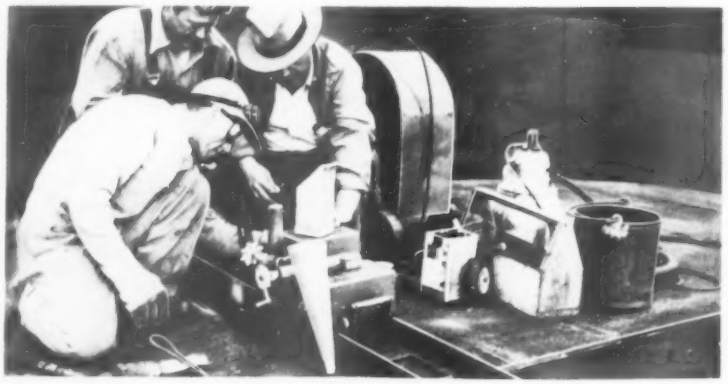
While the data from both units indicate efficient performance, it is interesting to note the difference in the yield, octane rating and consumption of acid in the instance where the feed contains a high percentage of propylene.

As shown in the accompanying tables, propylene is a satisfactory feed, but it does not produce as high octane numbers or consume as little acid as butylene alkylation.

			Butylene Mo. %	Propylene Mo. %
Olefin feed composition		C_3H_6	6.4	23.5
		C_4H_8	19.5	15.2
		iC_4H_{10}	33.8	29.9
		nC_4H_{10}	17.4	4.2
		C_4H_{8-1} / C_4H_{8-2}	20.5	23.8
		C_5H_{10} / C_5H_{12}	2.4	3.4
		Total	100.0	100.0
Acid consumption lbs./gal. total alkylate			0.7	1.05
Light alkylate inspections	°API		70.8	72.8
	ASTM Dist. °F	IBP	120	110
		10	180	150
		20	200	170
		50	220	200
		90	240	240
		EP	340	320
		% REC	98.0	99.0
	RVP		5.6	5.8
	Octane	F-1 Clear	96.2	93.4
Light alkylate yield (Basis total alkylate)			95 LV. %	93 LV. %

Kwinana Refinery Takes Shape

Work is proceeding steadily on the new Anglo-Iranian refinery at Kwinana, Australia. (Above) Progress on the Orthoflow Fluid catalytic cracking unit . . . the guy derrick is just being installed for lifting the various towers and vessels onto the foundations which may be seen in the center of the site. The unit will be a Model "B" Orthoflow in which the regenerator is located on top of the reactor to reduce compressor horsepower requirements. (Below) A typical example of the use of standard shop equipment in field fabrication. Shown is a portable continuous welding machine, being used here for the fabrication of tank shell plate.



Autofining Economics are Attractive . . .

Although Autofining, AIOC's new desulfurization process licensed by Kellogg, shows excellent economics in comparison with acid treating as a method of removing sulfur from kerosene, it shows an even more attractive payout time when it is used to treat gas oil.

The economic summary below takes into account direct operating costs and treating losses, but excludes taxes, depreciation, interest and royalty for both treating methods. Direct operating costs include labor, maintenance, utilities, chemicals and catalyst. Acid required for treatment of kerosene and gas oil is 15 and 40 lbs./bbl. respectively. The payout periods on incremental investment for the Autofining cases are very short, and the Autofining process appears to be both an economical and flexible method of reducing the sulfur content of straight-run petroleum distillates.

	KEROSENE (Sulfur reduced from 0.4 to 0.03 wt. %)		GAS OIL (Sulfur reduced from 1.1 to 0.6 wt. %)	
Investment, 3,500 BPSD Plant	$650,000	$320,000	$800,000	$320,00
Direct Operating Costs, $/Bbl	0.095	0.218	0.104	0.485
Treating Loss, Vol. %	0.5	4.5	1.5	10.0
Incremental Savings for Autofining, $/Year	305,000	—	748,000	—
Payout on Incremental Investment, Years	1.08	—	0.64	—

For further information, technical data, etc., on any refining process, write

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Does College Make an Engineer?

(Continued from page 226)

abled to judge rightly the merits of the various claims put forward in the process of constructing the cable. What kind of an education, what kind of a training, what kind of a tradition is it that will enable the proper judgment to be made, and the proper balance to be struck, between engineering experience and scientific theory? The story of Kelvin and the transatlantic cable gives us no positive answer. It does show some of the pitfalls that might be avoided. One who must make engineering decisions must himself have enough understanding of mathematics and of the nature of physical theory to be able to appraise its claims and to judge its value.

Engineering schools . . . For only something like 150 years have engineering schools been in existence and has engineering aspired to become a learned profession. Quite naturally the traditions of such schools are still in a state of flux, and their procedures are not as yet finally determined.

During the last three-quarters of a century the engineering schools have allied themselves with colleges and universities; they have often become part of universities and have given degrees along with other colleges. They have wanted to consider themselves as institutions of higher learning rather than as vocational or trade schools. But in this process they have not joined the universities as professional schools, such as those of law or medicine, but have come in on the level of the undergraduate arts college. Students have gone directly from high school into college to study engineering—not eventually, but right away.

As a consequence, in many cases, the engineering schools have been in the universities more than of them. But engineering schools, whether parts of universities or not, seem to have developed some characteristic traditions. The engineering student has put in long hours. The normal engineering load is 21 to 22 semester hours as opposed to 15 or 16 for an arts student. This has not been mere bookkeeping. The official 3 hours of work per week for each semester hour of credit is more nearly attained in engineering work, I believe, than elsewhere. Apparently this follows the old apprenticeship tradition. The work is hard and gruelling. It provides, possibly, moral discipline, but not necessarily much intellectual development.

The engineering schools also provide a certain amount of professional indoctrination. Students are encouraged to become student members of the professional societies, and to regard themselves as engineers and as distinct from other students in the university. The possibility that they may not practice engineering, but many turn to some other field, is ignored or at least is regarded as a defection.

Another characteristic of engineering schools may be typified by the recurrence of phrases similar to "the grimy engineers" in school songs. The students found it advisable to wear overalls in the laboratory and developed a certain pride in wearing them elsewhere as a badge of the profession. They very strongly professed the virtue of manual labor in supposed contrast to the lily-fingered students of literature and the arts.

By these means and others, the engineering schools tend to show their origin in the tradition of craftsmanship, in the emphasis on the immediate applicability of the matters they teach, and in their single-minded devotion to the detailed tasks they expect their students will be called upon to perform.

New plan . . . But if one undertakes to think out from the beginning what should be the nature of the work in universities for prospective engineers, he is met with several severely limiting factors.

In the first place, a student enters the university at a fairly early age to know really whether he wants to be, or should be, an engineer. Certainly his university experience should not be such as to be of value only when he pursues a rigidly established professional career.

In the second place, industries are tending more and more to draw technically trained men into management. One may conclude that the technical training is valuable in preparing a man for this kind of work, although the exact nature of the technical training is not very important.

In the third place, the art of engineering is so varied and is changing so rapidly, that it is increasingly difficult to prepare students for a specific job they may wish to undertake. A class of 25 senior electrical engineers may go to 25 different kinds of work, ranging from a street-car system, through the telephone business, to radio or television. Each will have to learn his particular job when he gets there. No amount of subdivision of the course into various options will replace this. Furthermore, the art is changing so rapidly that no laboratory can be provided with really modern equipment. Even though it is modern today, it is obsolete tomorrow.

What, then, can a college or university training do for a prospective engineer? How can it aid most in the necessary synthesis of theory and experience? What kind of studies or activity can be of most use to this widely diversified group, over the longest period of time?

General training . . . The thesis I should like to propose is that the proper function of the university is to contribute to the general education and to the scientific background of prospective engineers, rather than to their engineering experience. Experience can be better obtained in practical engineering situations. Science can be learned and understood best in a university.

Thus, I would propose that a university definitely does not and cannot "make" an engineer. An engineer needs extensive scientific study in a university, but he also needs real practical experience. I think most people agree with this, but perhaps not all follow it to its logical conclusion as to the proper function of a university. There is often a tendency to attempt to deal in the university with matters which can only be done well on a job.

Perhaps I may be permitted to describe to you the Rice Institute program for prospective engineers, which we believe goes at least a small way toward recognizing this function of a university to provide the general and scientific background against which an engineer must place his experience.

During the first 2 years at the Rice Institute a student who thinks he wishes to become an engineer is enrolled in what we call our science-engineering course. As a freshman he studies mathematics, physics, chemistry, English, and history. As a sophomore, he studies much the same things with the inclusion of a modern language and some engineering drawing.

These 2 years may be regarded in fact as a preengineering course. They give the student an acquaintance with scientific subjects, some of which will apply to his engineering. More than that, they give him an acquaintance through English and history with the broad humanistic problems which men have been meeting since the beginning of time.

An outstanding engineer must be a broadly educated, useful citizen as well as a technician; and it is our belief that these first 2 years of what might be called "general" studies lay a foundation which can be of great value to him in engineering as well as in almost any other profession, and without which he will be seriously handicapped.

At the end of 2 years the student can decide whether he still thinks he wants

to be an engineer. If he does, and if he has done satisfactory work in those courses which are regarded as specifically prerequisite for engineering work, he is allowed to continue. A certain fraction of students do not continue, but turn to other fields. I believe they find this preliminary training with its scientific emphasis to be of value no matter what their ultimate professional activities.

During the third year, engineering studies begin; and the students are given an introduction to the applications of science and to the basic techniques of engineering. In this work no distinction is made between the various kinds of engineering, and work in the humanities is not ignored but is continued. In the fourth year the amount of engineering work is increased and some slight distinction is made between the four fields of engineering which we cover, viz., chemical, civil, electrical, and mechanical.

Problems . . . One of the problems always met in setting up a program of this kind is associated with the common practice in this country of regarding 4 years as the appropriate college or university course. At the end of 4 years the student rather expects to have come to some kind of a stopping point. Nevertheless, in our program this is not the point at which the university's engineering work is completed. The engineering societies do not recognize this kind of work as a basis for an accredited degree.

We have met the problem by granting the student at the end of 4 years the degree of bachelor of arts. It is our belief that this is an appropriate description of his work. It contains a large fraction of science, a small amount of modern languages, work in history, English, and possibly economics or psychology. A student with this degree alone cannot become a registered engineer in Texas, but he has a good background for a great many activities in which a scientific training is of help; and I believe that industries will eventually recognize a training of this kind as a highly desirable one for men who may be recruited into departments not demanding highly technical engineers.

For those students who at the end of the fourth year still retain their interest in engineering as a profession, we provide a fifth year of work with emphasis on specific engineering studies. The subjects treated in this fifth year are treated in many institutions in the fourth year. Because of the greater age of our students, we are able to deal with the subject matter somewhat more intensively and thoroughly. At the end of the fifth year we then grant the student the degree of bachelor of science in his field of engineering.

Internship . . . It seems probable that there must eventually develop for engineers, as there is now for medical doctors, some scheme of engineering internship by which an engineer, after he has received his degree and completed his university work, spends one or more years in engineering employment which is specifically organized to give him practical experience. Many large industries provide something of this kind in their training courses, and it could be that further development along these lines can be expected.

Another difficulty with this approach to engineering is the continual extension of university time which it seems to indicate. I have been talking about a 5-year course at Rice. Cornell University and others also have 5-year courses for engineers. The medical profession has something like a 7-year course, and many worried students and parents inquire how far this will go, where is one going to stop? A student surely cannot spend all of his life in school; he must eventually begin to earn a living.

My own view on this problem is that its best solution comes at the lower end of the university. Many of the subjects with which we deal in our freshman and sophomore years could very well be done in high school. This seems to me particularly true of such subjects as mathematics, physics, and chemistry. It may very well be that a student needs to be at least 17 years old before he is mature enough to go away from home to a university in the ordinary way. No such maturity, however, is involved in studying analytical geometry and calculus. If these subjects, and the appropriate others, could be covered in our secondary schools, the university period might be shortened again to 4 years but a different 4 years from those ordinarily thought of.

Graduate training . . . I have not mentioned thus far another important feature of university work, which comes in the graduate school. In recent years an increasing number of engineers interested in the highly technical side of their activities have continued in university work for master's and doctor's degrees. This trend will probably continue. The applications of modern science to engineering are becoming more and more complicated and require a more and more thorough and detailed knowledge of the scientific foundations. Engineering schools have been slow to develop in this direction, partly because few industries have recognized its value, and partly because few engineering schools have understood its true nature.

In some cases, engineering faculties have measured graduate study in terms of years put in. They have regarded it as a means of acquiring additional experience in the tradition of craftsmanship. As such it is clearly of little value, for the experience would have been much more useful in the industry itself. Really advanced work in engineering schools must be in the academic tradition, not in the tradition of craftsmanship. It must have a highly mathematical and theoretical basis. It is not a study of engineering practice, but of engineering theory.

These men must devise the practice of the future. They are only incidentally concerned with the practice of the past. Much of the work will quite properly lead to the degree of doctor of philosophy because of its somewhat abstract nature. Other types may more properly be recognized by the doctor of science or doctor of engineering degrees, but the thing to be emphasized is that such work is not a substitute for practical experience. It is a different type of thing. It is intended especially for research and development engineers.

A petroleum engineer can learn in a university the sciences basic to his profession. In addition to mathematics, physics, and chemistry he would probably need to study geology. But the details of how to drill an oil well, or how to best recover the oil in a field, must await the up-to-the-minute practice he will find on the job.

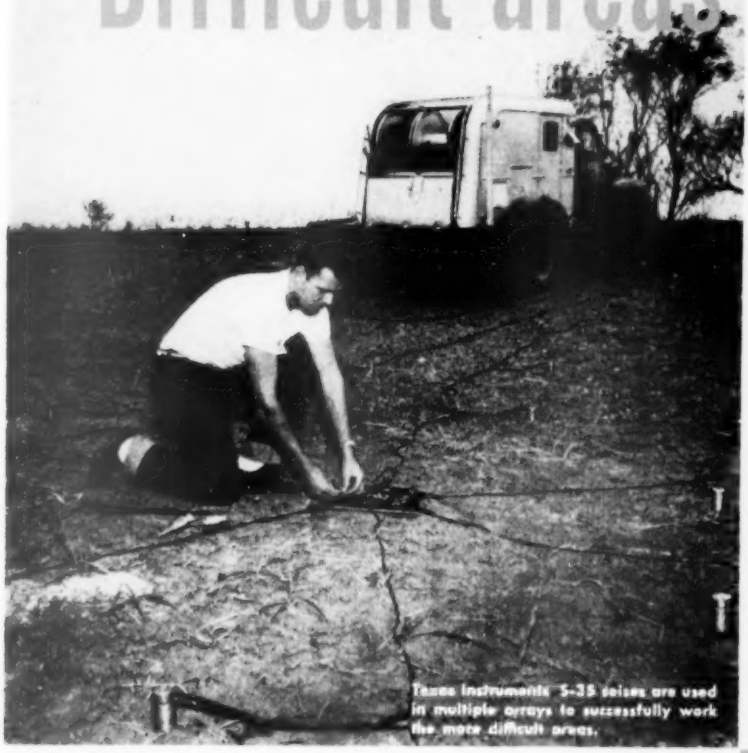
As I said before, my thesis is that the proper function of a university, and the only function in which a university can be really effective, is to provide the general education and the scientific background against which an engineer can place his experience.

One of the great pioneers in electrical engineering was Elihu Thomson. In fact, he organized one of the firms which were merged to form General Electric Co. In the preface to a biography of Elihu Thomson, Owen Young, of General Electric Co. makes special mention of Thomson's versatility of interest. He points out that although it is customary today to regard specialists very highly, Thomson was only a specialist in the sense that he sometimes devoted his attention to a special problem. Young coined for Elihu Thomson the rather formidable word of "generalist" and described Thomson not as a specialist, but as a generalist specializing.

Is it not possible that this is the secret of creative engineering, that creative engineering is done by a generalist specializing?

Difficult areas demand...

TI SEISMOMETERS



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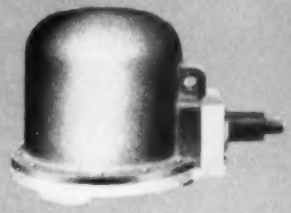
TI's tough, durable S-31 seismometer is unsurpassed where weight and size are of less importance. Larger than the S-34 and S-35, the S-31 is designed for dry land, truck-based operations.

TI MODELS S-34 AND S-35 SEISMOMETERS

SPECIFICATIONS

	S-34	S-35
Weight	1.25 lb	1.25 lb
Height	3 in.	3 in.
Diameter	1.75 in.	1.75 in.
Natural Frequency	17 ± 1 cps	17 ± 1 cps
Coil Resistance	175 ohms	750 ohms
Internal Resistor for 0.55 Critical Damping	150 ohms	680 ohms

MODEL S-31 SEISMOMETER



SPECIFICATIONS

Weight	3.5 lb
Height	3.5 in.
Diameter	4 in.
Natural Frequency	18 ± 1 cps
Coil Resistance	75 ohms
Internal Resistor for 0.46 Critical Damping	120 ohms

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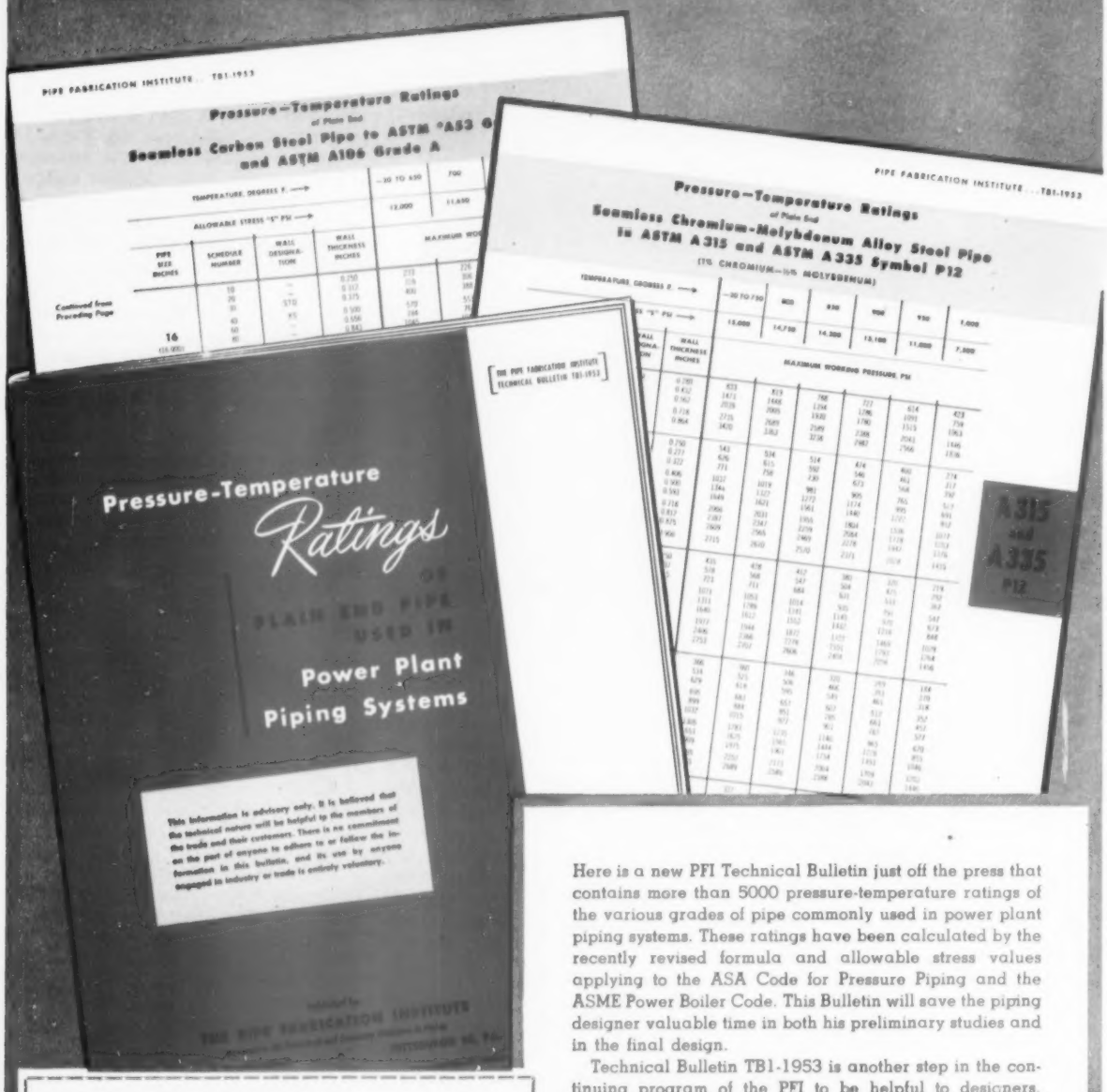
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Flexible Protective Casings

(Continued from page 219)

at 5.5 ft. below the base of rail do not exceed 5 per cent of the casing diameter. Therefore, total deflection of 5 per cent is a safe design and will not allow the transfer of any load from the casing to the carrier pipe.

Conclusions

1. The adoption of electronic computers for the solution of complicated and time-consuming problems in the pipe-line industry is worthy of consideration by pipe-line-company managements.

2. Economies can be effected by the use of electronic computers to determine periodically the optimum operating capacity of a line under a wide range of operating cost factors.

3. The adoption of Spangler's method for the design of flexible pipe casings by the A.P.I. would set a minimum recommended standard for use by the pipe-line industry. This would reduce the problems now encountered in casing design.

4. The casings installed to date by the reporting pipe-line companies, representative of the industry, are adequately designed from the standpoint of structural strength.

The assistance given the author by the following people is greatly appreciated and acknowledged. Without their help and advice this paper could not have been completed: Prof. M. G. Spangler, Iowa State College, Ames, Iowa; Harley Clark, I.B.M. Service Bureal, for technical help and use of electronic computers; Oklahoma Natural Gas Co., and Stanolind Crude Oil Purchasing Co., Tulsa, for use of their I.B.M. 604 computers.

Pipe-Line Diameter

(Continued from page 214)

mulas by appropriate adjustment of the terms C_1 (cost per inch of inside diameter per mile of pipe installed) and C_2 (cost per horsepower), by adding the sum of the present value of the annual pipe-line-operating cost over the anticipated life of the line (expressed in dollars per inch of inside diameter per mile) to the factor C_1, and the sum of the present value of the annual station operating costs for the same period (expressed in dollars per horsepower) to the term C_2.

The interest rate at which these annual costs would be reduced to present values would be that which represents the value of money to the individual company.

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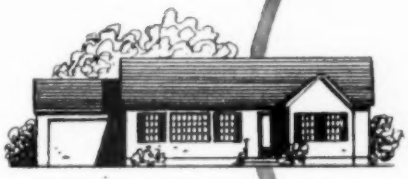

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How to Transport and Store Propane

(Continued from page 222)

can be opened or closed separately by a control located near the valve. In addition, master controls are spotted at various locations around the terminal. These master controls can close immediately all valves in the system in event of fire, line break, or other emergency.

Blowdown . . . The pumps at each pumping station on the pipe line are connected to a blowdown line. In event of a seal failure or any other type mechanical trouble while propane is passing the station, the contents of the pump may be quickly evacuated through this blowdown system.

Tariffs . . . Phillips Pipe Line Co. has published a special tariff covering transportation of propane on its system. This tariff provides that the shipper will own all storage, terminaling, and related facilities. Per barrel rates for propane are the same as for conventional products, the only difference being that a 2 per cent loss allowance is charged on propane shipments.

More L.P.G.

The need for efficient pipe-line transportation of propane is increasing. Production of L.P.G. products is constantly growing. Consumption of such products, usually at locations remote from the production source, is enjoying steady growth. As one example, internal combustion engines used 28 per cent more L.P.G. as fuel in 1952 than in 1951. At present, however, L.P.G. available for long-distance pipe-line transportation is but a fraction of the quantities of conventional products now being handled by all major pipe-line carriers.

A wholesale participation of the products pipe-line industry in transporting propane is not foreseen. Some systems, however, are geographically located to connect large sources of L.P.G. with concentrated markets. These systems will probably be called upon to regularly transport propane and other L.P.G. products. Propane transportation in products pipe-line systems will face two major problems. The first will be the high cost of conventional storage to the shipper. Underground storage will minimize this problem in some instances. The second problem, as discussed above, will be that of economically maintaining the critical specifications during pipe-line transportation.

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TOTCO men make the rough calls in stride . . . hundreds of trips into swamps, in the desert, and over boggy roads at night and in storms. Our service organization will go on making all the trips you need anytime, anywhere.

But the *values in service* to you are (1) trained men able and *willing* to help you, and (2) our responsibility to build the finest Recorder . . . one that will give the ultimate in trouble-free operation.

The TOTCO service organization has been building for twenty years . . . a long-time association with drilling requirements. You'll find TOTCO organized to gain your appreciation . . . because our service is based on what we've learned you want.

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YOU CAN TAKE TOTCO READINGS ANYTIME

Run in and out on measuring line.

Dropped down drill pipe; picked up with core barrel overshot.

Dropped down drill pipe; recovered when bit is changed.

Run in the Recorder connected to a core barrel overshot when picking up a retractable core barrel.

Run in and out on ordinary sand line.

Be **SURE** *you know, use* **TOTCO**

New Foam Cuts Evaporation Losses

(Continued from page 224)

temperature reading. Those which float on top of the thief can be poured off with the top few inches of oil. If Microballoons get into a sample from which a b.s. and w. reading is made, they rise to the top of the centrifuge tube and do not cause errors.

Life of Microballoons . . . Practical service life will be decided only in the field. At present, examination of the covering on large tanks in service for over 1 year have shown no change in thickness or appearance. As shown below, measurements on foams in drum-scale storage for 2 years indicate no significant changes.

	1951	1953
Density (g./cc.):		
Liquid displacement	0.21	0.22
Gas displacement	0.29	0.26
Average particle size (microns)	18.9	19.6
Particle size range (microns)	0.5 to 60	0.5 to 60

The very slight density differences indicate that the particles are not filling with liquid by diffusion through the walls. These data would suggest a lifetime in crude-oil service considerably longer than the required economic life. The life of the protective foams on actual tankage will probably depend more on frequency of tank cleaning which might result in the loss of part or all of the Microballoons, and on operational mishaps such as pumping the foam out of the tanks. When a tank with a Microballoon covering is cleaned it may be possible to save substantial amounts of the foam material for reuse.

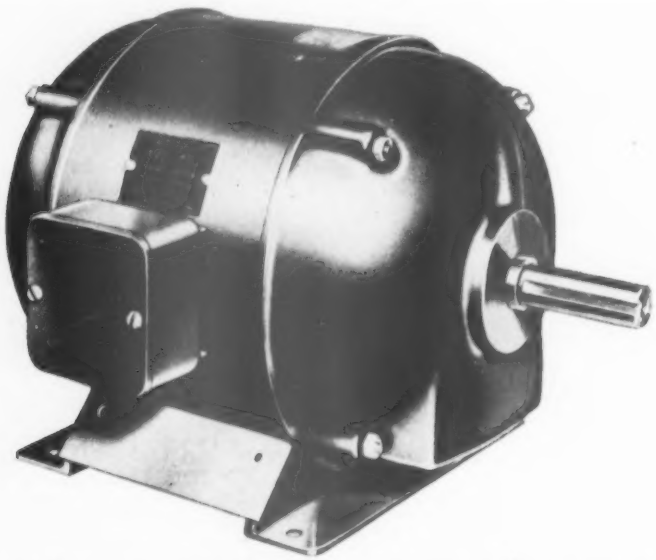
Protection against loss . . . Since the foam covering is relatively valuable its loss should be avoided. With Microballoon-covered tanks, it will be necessary to guard not only against overflow, but also against pumping a tank too low. With sufficient stress by the operators on the low-level shutoff point, the loss of Microballoon should be kept to a relatively minor occurrence.

The shutoff height should be established so that vortexes will not cause the loss of Microballoons. It is anticipated that the foam on top of the crude oil in the tank will substantially reduce the vortex height because it tends to prevent the surface of the oil from moving in a circular motion. In tanks equipped with swing lines the shutoff height must be set above the swing-line height.

Automatic Shutoff Valves

Automatic shutoff valves are an answer to the loss of Microballoons on small tanks which are not equipped with swing lines. Since these valves are presently made only in the smaller sizes they will only be useful on tanks where the withdrawal rate is relatively low. They will also aid in preventing loss of Microballoons on isolated gathering tanks which are commonly pumped out until shut down by loss of flow.

In the event that Microballoons do get pulled out of the tank, they will not damage pumping equipment, meters, or other mechanical apparatus. They are plastic material and much less abrasive than the sand or scale which is found in small amounts in most crude oil. If they are drawn into a pipe line that is operating at more than a few hundred pounds per square inch, they will be crushed and will end up in b.s. and w. They should not have any harmful effect on refinery units since they are made from a thermosetting resin and will not soften or liquefy at high temperatures and should end up in asphalt or coke.



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When buying cellar control gates . . .

Get ALL the facts...

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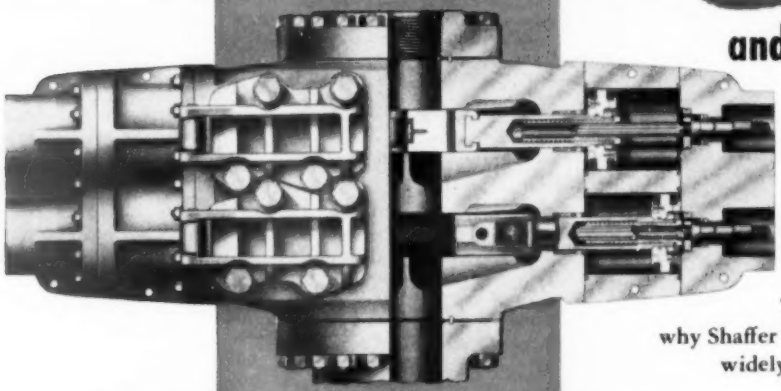
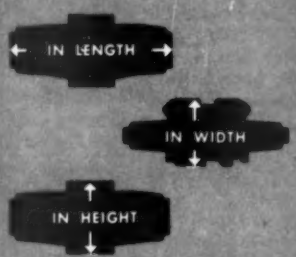


When you buy cellar control gates, it pays to *double*-check the features built into the various units you are considering. Here at Shaffer we not only welcome your making such a comparison – we strongly *urge* you to do so. This way you will appreciate more fully why Shaffer Hydraulic Cellar Control Gates are so widely recognized as the finest in the industry.

For Example . . .

take

Compactness



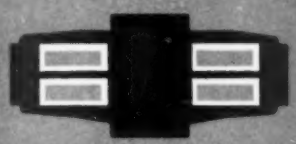
Shaffer Hydraulic Cellar Control Gates are not only unusually compact – in height, width, length – but equally important, you don't have to allow *extra* space above them for changing rams – nor do you have to allow extra space at both ends of the gate for expanding the unit to remove and replace rams.

Rams in Shaffer Hydraulic Gates are quickly changed through patented side-opening doors. Simply unbolt and swing open the door . . . change rams . . . and bolt the door shut again. Closing the door automatically aligns the rams within the gate. Even in sizes as large as 13⅝" (12" Series 900) the gate height is only 30" – and this is *total* required height – *no extra space need be allowed for servicing the rams!*

---

and

Convenience



With Shaffer Hydraulic Gates there's no need to dismantle the upper unit in order to change rams in the lower unit. You can change rams in *either* unit without in any way disturbing or disconnecting the *other* unit. Each is completely independent of the other – a valuable safety, as well as time-saving, feature!

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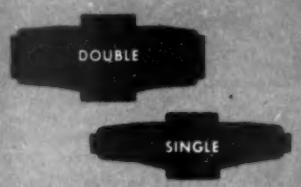
and

Versatility



Only Shaffer provides a choice of either Single or Double Hydraulic Gates – whichever best meets your requirements. Rams and most other parts are interchangeable, size for size, between Single and Double Gates, assuring you maximum adaptability to *your particular needs* – at minimum inventory and maintenance costs.

---

and

Dependability

Every model of Shaffer Cellar Control Gates has been *field-proven* under widely-varying types of operations and different field conditions. Get Shaffer Hydraulic Gates for the safety and all-around pressure protection so vital in cellar control gates!

The above are only a few of the MANY important advantages you get in Shaffer Hydraulic Cellar Control Gates. We'll gladly supply further details direct – or see your nearest Shaffer representative.

Send for your free copy of the latest Shaffer Catalog!

Remember **Shaffer also manufactures a complete line of Mechanical Cellar Control Gates—both Single and Double Types—for those desiring this type of equipment. Rams are interchangeable, size for size, with those in Shaffer Hydraulic Gates.**

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Guides to Future Oil Traps

(Continued from page 234)

leur Islands. This island was only 0.3 mile long in 1922, and it now exceeds 4 miles in length.

In contrast, a chain of barrier islands, which formerly existed to the north of Baptiste Collete subdelta, has virtually disappeared (Fig. 6). It seems likely that these islands have been eliminated because a source of sand which existed up to recent times in the strait inside Breton Island has been covered with fine sediment which began to be introduced to this area in large volume when Main Pass was created. Because this burial eliminates the sand necessary for the maintenance and growth of the islands, they have now retreated, having been largely truncated by waves.

Fig. 6, based on project cores and on charts dated from 1838 to 1952, shows the growth of the Baptiste Collete subdelta, the retreat and final truncation of the island chain, and its subsequent burial. The nature of the sediments associated with these events also is indicated. Such disappearance of sand islands can leave a submerged sand body of considerable thickness. Some of the wells in the barrier island outside Mississippi Sound have penetrated sand to depths of 250 ft. The growth of the muddy sediments of a delta over the eroded top of one of these elongate sand masses may develop a satisfactory stratigraphic trap for future oil accumulation. Similarly, the eastward march of the delta is causing fine sediments to overlap on the older sands of the Continental Shelf and, hence, may develop other potential stratigraphic traps in the future.

Rates of Sedimentation

In the past marine geologists learned far more about rates of sedimentation on the deep ocean floor than on the shallow shelves around the continents. Most of the shelf areas studied in earlier operations have apparently had little or no deposition in the past 10,000 to 20,000 years, i.e., since the melting of the ice sheets caused a general rise of sea level. The finding of glacial-age sediments on the shelves led some authorities to the belief that shelves, in general, are not areas of deposition except very near the shore. However, our studies along the Gulf Coast show definitely that postglacial deposition is progressing at appreciable rates in many places on the open shelf.

The very rapid shoaling during the past century on the shelf outside the Mississippi Delta, mentioned previously, provides the best evidence, although this is in a very special environment because of the great size of the river. A line of cores taken off Aransas Pass, Texas, out to the edge of the shelf suggests the existence of modern sediments because of the great uniformity of the silty clays which extend the entire length of 7 to 9 ft. cores taken beyond the 20-fathom line. If the sea had retreated during a glacial stage, there should be sand layers; or at least the clayey sediments deposited prior to lowering of the sea level would show greater compaction than subsequent sediments. The faunas indicate that these sediments have been accumulating at approximately the same depths as those which now exist, and this fact also suggests that they are postglacial. However, along other portions of the continental shelves, sands indicative of shallow-water conditions, or even barrier islands, are found. The associated faunas confirm the change of conditions since the time when these coarse sediments were deposited.

We are finding that the shelves are, at least locally, sites of deposition which may yield future sedimentary rocks, but that elsewhere conditions of nondeposition exist on the sea floor.

The rate of sedimentation, or at least a bay fill, is particularly well known along the Texas coast because of the completeness of old surveys and because of the relative ease of comparing the soundings taken as long ago as 100 years with those depths now existing. Thousands of depth comparisons have been made. The results have been translated into contour maps which show the amount of depth change between old and new surveys.

Bays have been filling so rapidly that they may cease to exist in a few hundred years. The general fill is supplemented locally by very rapid encroachment onto the bays as the result of delta building of the larger rivers. However, there are strong indications that subsidence is taking place at the same time, so that an increase in the rate of this subsidence may reverse the trend in the bays some time in the future and may even cause the bays to increase in depth and area. Taking into account a probable present-day rate of subsidence, it is estimated that the average rate of sedimentation in the Texas bays is close to 3 ft. per century.

Mechanism of Displacement of Oil

(Continued from page 242)

set up across them are accordingly difficult to analyze. Capillary pressures, then, should be taken as statistical averages rather than the manifestations of simple physical structures.

It is apparent, too, that the surface forces are operative over short lengths of pore walls, as against the relatively long walls of capillary tubes. This factor must be taken into account in correlating capillary pressure and pore sizes. Indeed, it also indicates the need to investigate the effect of short pore lengths on capillary pressures. The surface forces act within microsaturation structures in such a manner as to indicate that the rate at which contact angles find their equilibrium positions could be influential in determining production performance. These are concepts which are new in reservoir considerations, and have waited for microstudies to point out their significance.

In themselves, the shape and position of the microstructures have a bearing upon the behavior of reservoir systems. The structures are aligned in the general direction of flow. Consequently, the systems are characterized by directional variations in flow properties arising from the microsaturation distributions alone. The flow structures are usually larger than the pore dimensions. Thus, even in the flow of immiscible liquids, the rock pore remains one of the critical parameters which govern the flow. For the first time direct visual evidence has been gathered to substantiate the idea that the flow structures of the wetting phase tend toward the tighter spaces in the rock matrix, whereas those of the nonwetting phase tend toward the looser openings.

Up to this time, then, microscopic investigations of flow mechanisms have been critical in the establishment of flow structures; i.e., these investigations have presented the mechanistic microbehavior during displacements; they have delineated the operative areas for the viscous and surface forces; and they have indicated new parameters for consideration in reservoir processes.

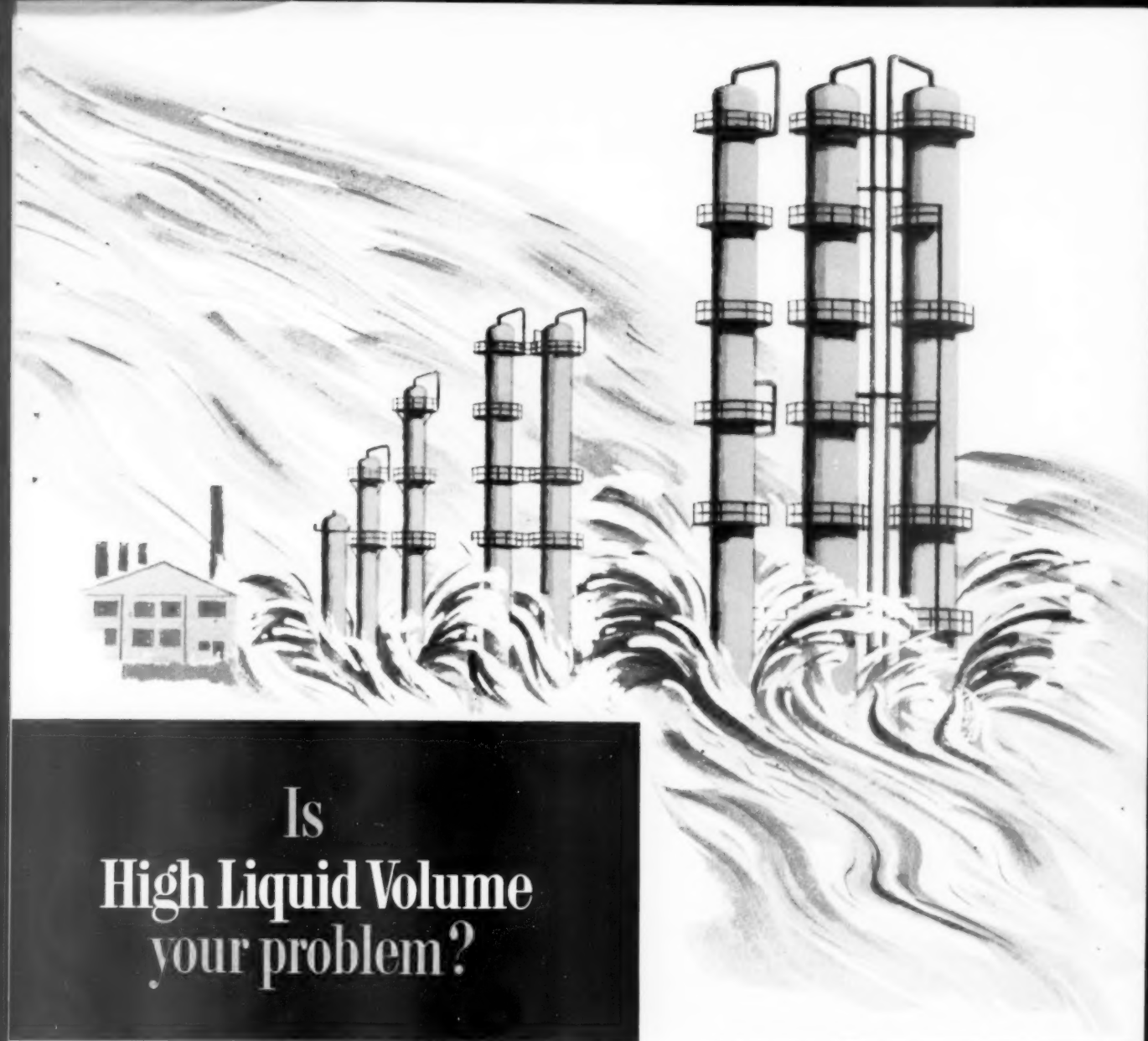
BOOKS

OIL AND PETROLEUM YEAR BOOK, 1953. Compiled and published by Walter E. Skinner, 20, Copthall Avenue, London, E.C.2. 628 pp. $4 postpaid.

Complete and up-to-date particulars are given concerning 842 companies operating in all parts of the world and covering all branches of the oil industry, together with a list of the names and addresses of 567 managers and engineers and the companies in the book with which they are connected. The volume contains information on the principal British, American, Canadian, and foreign companies. The particulars of each company include names of directors and other officials, description of business, where operating, crude-oil production, refinery runs, details of capital, dividends, and financial results.

SYMPOSIUM ON CONTINUOUS ANALYSIS OF INDUSTRIAL WATER AND INDUSTRIAL WASTE WATER. Published by American Society for Testing Materials, 1916 Race Street, Philadelphia. 64 pp. $1.50.

Industry, having recognized water as an essential engineering material, is frequently called upon to evaluate its properties, both from the standpoint of its use and its disposal. Precise analytical determinations are necessary if equipment is to function properly, and the frequency of sampling and analysis has become great. Continuous analysis has therefore become essential, and with the present-day increase in labor costs, emphasis is being placed on the use of automatic equipment. The six papers in this symposium treat on these phases of the subject.



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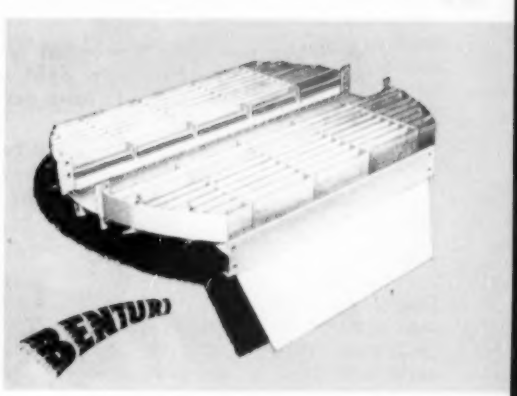

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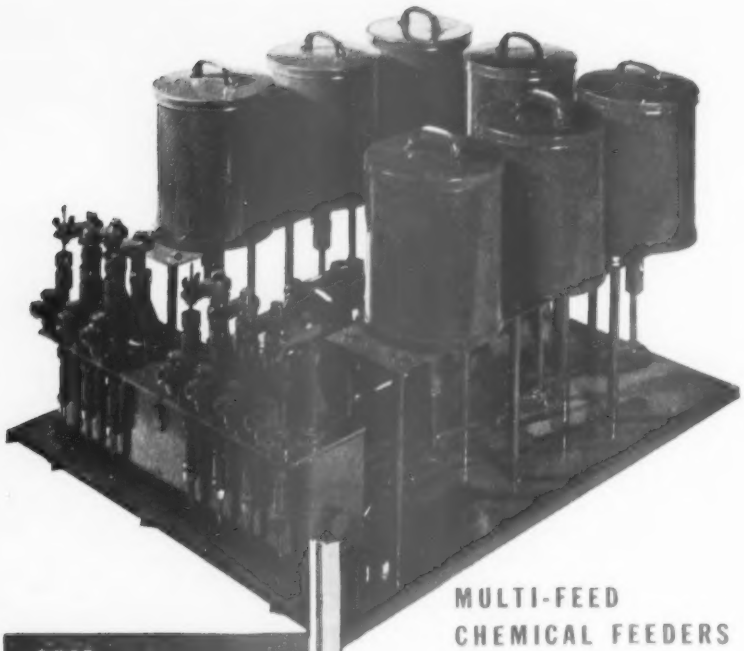

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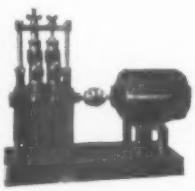

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Tidelands Oil: Bonanza, or Headache?

(Continued from page 298)

islands within 3 leagues of its coast when it was admitted to the Union, its boundary extended seaward 3 leagues.

Beyond 3 miles . . . If the Department of State of the United States continues to pursue the foreign policy announced by its deputy legal adviser while testifying before the Senate interior and insular affairs committee on the Submerged Lands Act,[11] it may take the position that the rights of the gulf states to the submerged lands between 3 miles and 3 leagues is something less than their rights to the area between the base line and 3 miles.

The deputy legal adviser testified that the United States did not claim vis-a-vis the other nations that its territorial sovereignty extended beyond 3 miles. He said the department did contend, though, that the United States, or the states, in the event the United States delegated the power to them, could lease and manage the natural resources of the seabed to the outer edge of the Continental Shelf without exercising territorial sovereignty over the area.

Whether the United States has territorial sovereignty over the area beyond 3 miles is not decisive of the question of whether Congress has empowered the Gulf Coastal states whose boundaries extended 3 leagues into the gulf when they came into the Union, to lease and manage the submerged lands between 3 miles and 3 leagues. This question must be decided by a proper construction of the Submerged Lands Act, and a correct application of the domestic law of the United States.

The Submerged Lands Act and its legislative history show that Congress intended to vest in some of the Gulf Coastal states management and the leasing rights over the seabed out to 3 leagues. The foreign policy of this nation regarding the extent of its territorial sovereignty cannot take from the coastal states rights which Congress granted them under our domestic law.

Leases Validated

Each lease issued by a coastal state which had been maintained in force and effect until June 5, 1950, was validated by the Submerged Lands Act. Lands restored to the states were impressed with each such lease. Moreover, the primary term of each lease was extended for a period from May 22, 1953, equal to the term remaining unexpired on December 11, 1950. The extension covered the period during which the

lessee was enjoined by the Supreme Court from conducting operations.

The lessee, however, was required to pay to the state issuing the lease, within 90 days from the effective date of the act, all rentals and royalties payable under the lease after June 5, 1950, or to consent in writing for the United States to pay such sums to the state in the event the lessee had paid the rentals and royalties to the United States.

Future operations . . . The states will not have exclusive jurisdiction over all operations to be conducted upon the submerged lands returned to them by the Submerged Lands Act. The United States retained all of its navigational servitude and rights in and powers of regulation and control of the lands and the navigable waters for the constitutional purposes of commerce, navigation, national defense, and international affairs.

The rules and regulations of the United States Coast Guard and the United States Corps of Engineers will continue to apply and must be obeyed.

The states will have control over all geophysical, exploratory, and production operations to be conducted on the lands returned to them by the Submerged Lands Act, but only to the extent that the exercise of such control will not conflict with the rights retained by the United States.

Many of the states have regulations governing these operations. In California, permits to conduct geophysical explorations must be obtained from the State Lands Commission, and from the Fish and Game Commission. The State Lands Commission may lease the submerged lands for oil and gas only when deposits are known or are believed to be contained in such lands, and are being, or may be drained by wells on adjacent lands.[12]

A change in the California law which would permit the leasing of offshore areas not known to be productive, and the construction of platforms on the floor of the sea, would increase the exploratory operations and the daily production.

In Louisiana, a permit to conduct geophysical operations must be obtained from the State Mineral Board and from the Department of Wild Life and Fisheries. The State Mineral Board may offer any of the submerged lands for lease on competitive sealed bids.[13] The board sold many leases before the filing of the Louisiana case. A continuation of the leasing policy will bring about much new exploration and development.

In Texas, a permit to conduct geophysical operations must be obtained from the Commissioner of the General Land Office. A fee of $50 per day per crew is charged for the permit. An inspector is assigned by the commissioner to each crew and an additional fee of $35 per day is assessed for his services where the operations are to be conducted within 1 mile of the coast and $15 per day where they are to be conducted farther seaward. The School Land Board may offer any of the submerged lands for lease on competitive sealed bids.[14]

The board has pursued a sound leasing policy under adequate state laws. It has encouraged offshore exploration and development. Shortly after the passage of the Submerged Lands Act the board published notices that it would, on December 1, 1953, offer several tracts for lease within 9 miles of the coast of Texas.

The states will have exclusive jurisdiction over conservation of the natural resources under the lands returned to them. Texas and Louisiana, two of the larger producing states, have adequate conservation laws which are being capably administered. Other states may find it necessary to amend their conservation laws.

2. Federal Areas

The area of the Continental Shelf to be administered by the federal Government under the Outer Continental Shelf Lands Act is 10 times larger than the area restored to all of the littoral states. It includes all of the shelf seaward of a line 3 miles from the coast of the United States, or 3 leagues from the coast of the Gulf of Mexico as to those states whose original boundaries extended into the gulf 3 leagues.

Unlike the states, the federal Government has never leased for oil and gas any submerged lands adjacent to the shores of this nation. The first law which authorized it to lease offshore lands was signed by President Eisenhower on August 7, 1953.

Leases Validated

Prior to the decisions in the Louisiana and Texas cases, a part of the outer Continental Shelf was under the jurisdiction of Louisiana and Texas. These two states, during the time they exercised jurisdiction over the area, sold many leases in good faith. Each lease sold prior to December 21, 1948, which had been maintained in force and effect under their laws until June 5, 1950, was validated by the Outer Continental Shelf Lands Act.

However, the Secretary of the Interior was authorized to promulgate regulations which are to constitute some of the provisions of the validated leases. He cannot, by his regulations, decrease the area or exclude any mineral included in the lease, or increase the rentals and royalties, or reduce the term of the lease. He has not promulgated these regulations. They will have an important bearing upon future operations under the leases. They should not impose any greater burden on the lessee than was imposed by the lease at the time it was purchased.

The primary term of each nonproducing lease was extended for a period from August 7, 1953, equal to the unexpired primary term of the lease on December 11, 1950. This extended term will give the lessee an additional time within which to discover oil and gas, and was granted because he was enjoined on December 11, 1950, from conducting exploratory operations.

Any lease whose primary term had not expired on August 7, 1953, which included sulfur, will expire as to the sulfur at the end of the primary term unless sulfur is being produced, or operations are being conducted for the production of sulfur. If the primary term of the lease expired before August 7, 1953, the lease will continue as to the sulfur for a period of 2 years from August 7, 1953, and as long thereafter as sulfur is produced or operations are being conducted for the production of sulfur.

Lease limitations . . . The validation of the leases was conditioned upon the lessee complying with certain provisions of the act, including the filing of a copy of the lease with the secretary, accompanied by a certificate from the state issuing the lease that it was in force and effect under its laws on June 5, 1950, and the payment of all rentals and royalties accruing after June 5, 1950, which had not been paid either to the state or to the United States. No lease validated under the act will continue beyond 5 years from August 7, 1953, in the absence of production or drilling operations.

The lessee must pay to the United States, as an additional royalty a sum equal to the amount of any severance, gross production, or occupation taxes which would have been collected by the state under its laws as they existed on August 7, 1953, had the state continued to exercise jurisdiction over the area. The additional royalty was imposed by Congress to meet the argument of some of the states that the lessee would receive a windfall if the

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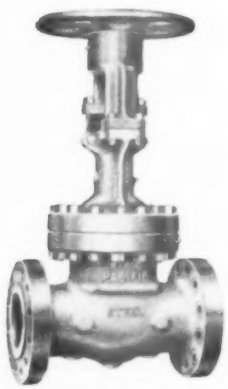

Fig. No. 650—6"

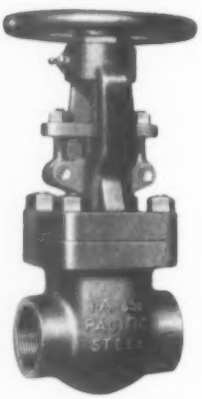

Fig. No. 3651—1½"

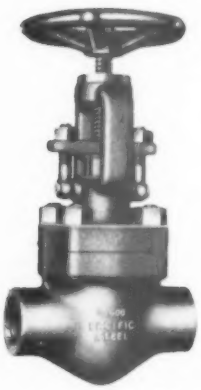

Fig. No. 3661—¾"

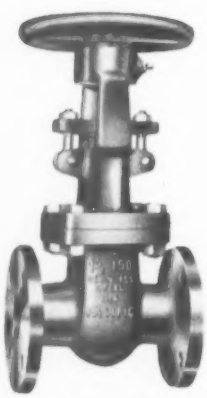

Fig. No. 500—1½"

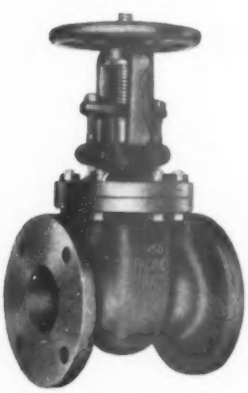

Fig. No. 8550—3"

states were not permitted to collect the taxes imposed by their laws upon such production.

The additional royalty will not apply to any lease sold by the United States. It applies only to leases sold by the states at a time when the taxes could have been collected on the production.

Some of the leases issued by Louisiana and Texas which were validated by the Submerged Lands Act and the Outer Continental Shelf Lands Act include lands partly within the jurisdiction of the state and partly within the jurisdiction of the United States. These leases were issued by the two states at a time when they were claiming ownership of a much larger portion of the Continental Shelf than was quitclaimed to them by the Submerged Lands Act. The leases split by this line have, in effect, been divided into two separate leases—one covering lands beneath navigable waters within the jurisdiction of the state, and the other covering outer Continental Shelf lands within the jurisdiction of the United States.

Jurisdiction hazy . . . I repeat that the line delimiting the area within the respective jurisdictions of the two governments has not been definitely established. Until it is established the lessee will have much difficulty in determining whether he is to comply with the laws of the state or with the laws of the United States. If he locates a well on what he believes to be a part of the lease under the jurisdiction of the state, it may subsequently develop that the well is located on lands of the United States.

Congress attempted, in §7 of the Outer Continental Shelf Lands Act, to solve in part a situation where a controversy existed between the United States and a state over the location of the dividing line. It authorized the United States and the state and the lessee to enter into a stipulation impounding the rents and royalties. A more complete solution of the problem must be found to assure an adequate development of disputed areas, and to reduce the risks that will be incurred if an operator spends many thousands of dollars without knowing which government owns the area in dispute.

Future Leases

The Secretary of the Interior may in the future lease any part of the outer Continental Shelf for oil and gas, or for sulfur, but he cannot include in one lease oil, gas, and sulfur.

He can determine the areas to be offered and when to be offered. All leases must be sold after published notice on sealed bids under regulations promulgated by him in advance. He must determine in advance of the sale

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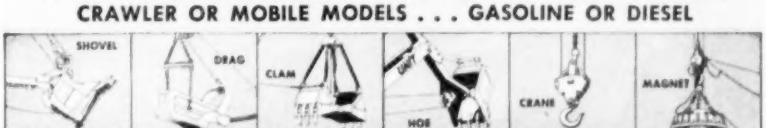

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whether he will receive bids on the basis of a cash bonus with a royalty fixed by him, or on the basis of royalty with a cash bonus fixed by him.

An oil and gas lease must cover a compact area not exceeding 5,760 acres. It will continue for a period of 5 years and as long thereafter as oil or gas is produced in paying quantities, or drilling or well-reworking operations to be approved by the secretary are conducted on the premises. It must require the payment of a royalty of not less than 12½ per cent in amount or value of the production saved, removed, or sold from the premises. It may contain such rental provisions and other provisions as the secretary may prescribe at the time of offering the area for lease.

Water operations are quite different from land operations. This difference was recognized by Congress when it prescribed in the Outer Continental Shelf Lands Act a leasing policy wholly dissimilar to that contained in the Mineral Leasing Act. A fortiori, the regulations applicable to the two types of operations must be different.

The secretary has not promulgated rules and regulations for the leasing of the outer Continental Shelf nor has he published a lease form. When published, if the regulations and lease form permit government intervention only when necessary to protect the rights of the United States, more operators will spend more money to find more oil.

Geophysical exploration . . . Geophysical operations are under the jurisdiction of the Secretary of the Interior. He may authorize any person to conduct these operations on any leased or unleased areas, provided they will not interfere with or endanger actual operations under a lease, or harm aquatic life.

The secretary on September 22, 1953, promulgated a temporary rule regarding these operations.[15] The rule applies only to those areas included in an agreement between the secretary and the appropriate state officials for the protection and conservation of aquatic life. In such areas, an operator may conduct geophysical operations on the outer Continental Shelf if he has obtained a permit from the state for similar operations on the adjoining areas under the jurisdiction of the state; has obtained a permit from the Corps of Engineers, and complies with the rules of the adjoining state governing operations on submerged lands of the state.

An agreement of this character has been entered into between the secretary and the State of Texas. While it is in force and effect all geophysical operations on the outer Continental Shelf opposite the coast of Texas must be in conformity with the rules promul-

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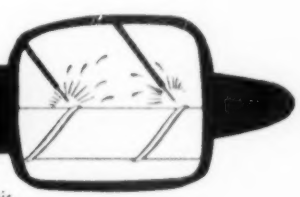

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gated by the Commissioner of the General Land Office of Texas.

Laws applicable . . . The laws applicable to the waters above the outer Continental Shelf are not the same as those applicable to the natural resources of the outer Continental Shelf, and to the structures erected for their removal. The United States still recognizes as high seas, the waters above the outer Continental Shelf. The rules of international law regarding freedom of the seas are applicable to these waters. Foreign vessels can navigate them without obtaining permission from this nation.

The Deputy Legal Adviser of the State Department, while testifying before the Interior and Insular Affairs Committee of the Senate on the Outer Continental Shelf Lands Act, said that from an international standpoint the United States should not claim territorial sovereignty over the waters and air space above the outer Continental Shelf. He said, however, that no principle of international law would be violated if the laws of the United States were applied to the natural resources of the subsoil of the outer Continental Shelf, and to the structures erected on the shelf for their removal.[16]

Many of the states urged Congress to permit them to extend and enforce their laws to the portions of the outer Continental Shelf opposite their shores. Their contentions were met with vigorous opposition by federal officials. After a long hearing and debate, Congress settled the controversy by extending to the subsoil and seabed of the outer Continental Shelf all federal laws, and such state laws as are not inconsistent with the federal laws. It charged the federal officials with enforcing these laws, and denied jurisdiction to the states.

The areas of the outer Continental Shelf over which the federal officials will apply the state laws are to be defined by the President. In defining the line, he is required to extend the boundary lines of the littoral states seaward to the outer edge of the Continental Shelf. To date he has not delimited these areas. When he does, an operator searching for oil in the area must first examine the federal laws, and then the state laws, and then determine the extent to which the state laws are not inconsistent with the federal laws.

Workmen's Compensation Laws

The Workmen's Compensation laws of a littoral state will not apply to an employe working on structures erected on the outer Continental Shelf. The act expressly provides that compensation shall be payable under the provisions of the Longshoremen's and Harbor Workers' Compenstion Act to an employe who is disabled or killed while engaged in operations on the outer Continental Shelf. The benefits under the Longshoremen's and Harbor Workers' Act are much larger than those under the Workmen's Compensation laws of the states. The larger benefits will further increase the cost of producing a barrel of offshore oil.

However, the Longshoremen's and Harbor Workers' Compensation Act does not apply to a master or a member of a crew of a vessel. The Jones Act[17] covers all seamen injured while engaged in operations on the outer Continental Shelf. In general, a seaman is one employed to navigate vessels upon the sea, but includes all those on board whose labor contributes to the accomplishment of the main object in which the vessel is engaged.[18]

The Jones Act, unlike the Workmen's Compensation laws of the state, imposes no limitation on the amount of damages an injured seaman may recover. The employer must determine whether his employe will be a seaman under the Jones Act, or an employe under the Longshoremen's and Harbor Workers' Compensation Act.

National Labor Relations Act . . . The adventurous operator who goes to sea to produce oil will not escape the harassment of the Taft-Hartley law. Like the proverbial shadow, the National Labor Relations Act will follow him all the way to the edge of the outer Continental Shelf. If he commits an unfair labor practice, the Labor Board will not try him on the structure, but it will try him in the judicial district of the adjacent state nearest the structure.

Coast Guard and Army Engineers . . . The Coast Guard has the authority to promulgate and enforce reasonable regulations with respect to lights, warning devices, safety equipment, and other matters relating to the promotion of safety of life and property on a structure. It may mark, at the expense of the owner, for the protection of navigation any structure which the owner has failed to mark in accordance with its regulations. A person violating any lawful rule or regulation will be guilty of a misdemeanor and may be fined not more than $100.00 for each offense. Each day during which the violation continues will constitute a new offense.

The industry may find it necessary to ask the Coast Guard to eliminate some of its rules which are unnecessary and materially increase the cost of operations.

The secretary of the Army will have authority to prevent obstructions to navigation in the waters above the outer Continental Shelf, even though the waters are a part of the high seas. He can establish sea lanes and anchorages, and restrict or eliminate drilling in the areas.

Suspension of operations . . . The Secretary of the Interior, upon recommendation of the Secretary of Defense, during a state of war or national emergency declared by Congress or the President, may order operations suspended under any lease, but just compensation must be paid by the United States to the operator.

The Secretary of Defense, with the approval of the President may designate restricted areas needed for national defense. No operations can be conducted in a restricted area without the approval of the Secretary of Defense. When operations under a lease on a restricted area are suspended, all obligations under the lease likewise will be suspended, and the trm of the lease will be extended for the period of suspension. Just compensation must be paid to the lessee for any damages suffered on acount of the suspension of operations.

These unusual provisions, which Congress deemed necessary for the defense of this nation, are cumulative evidence of the increased hazards of offshore operations.

Pipe Lines

Pipe-line easements may be obtained from the secretary under regulations promulgated by him. An operator who obtains an easement for an oil pipe line, or a gas pipe line, must transport or purchase, without discrimination, oil or natural gas produced from the submerged lands in the vicinity of the pipe line in such amounts as the Federal Power Commission, in the case of gas, and the Interstate Commerce Commission, in the case of oil, may, after a full hearing, determine to be reasonable, taking into account, among other things, conservation and the prevention of waste.

Conservation regulations . . . The secretary is authorized to promulgate and enforce rules and regulations for the prevention of waste and the conservation of the natural resources of the outer Continental Shelf, and for the protection of correlative rights. Any person who knowingly and willfully violates any of these conservation rules will be guilty of a misdemeanor, and punishable by a fine of not more than $2,000, or by imprisonment for not more than 6 months, or by both such fine and imprisonment.

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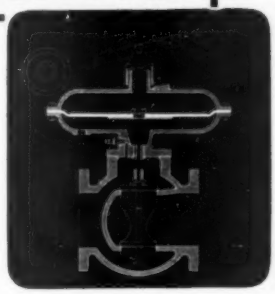

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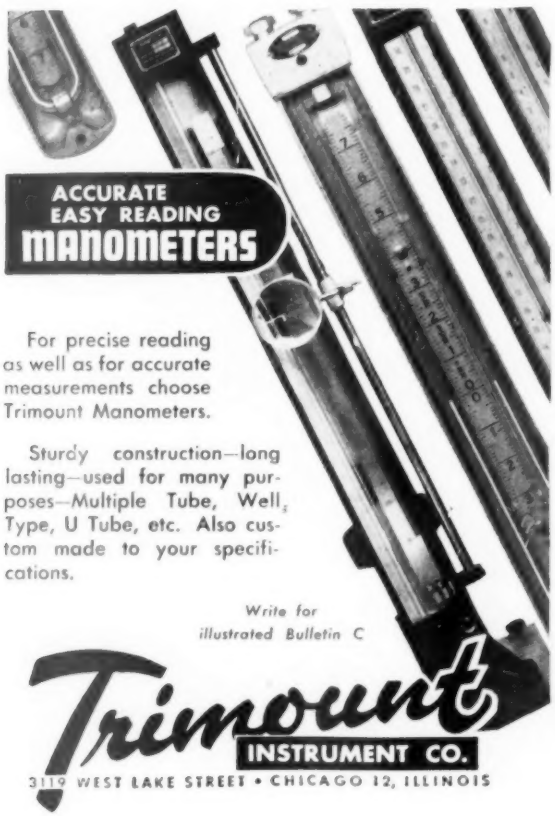

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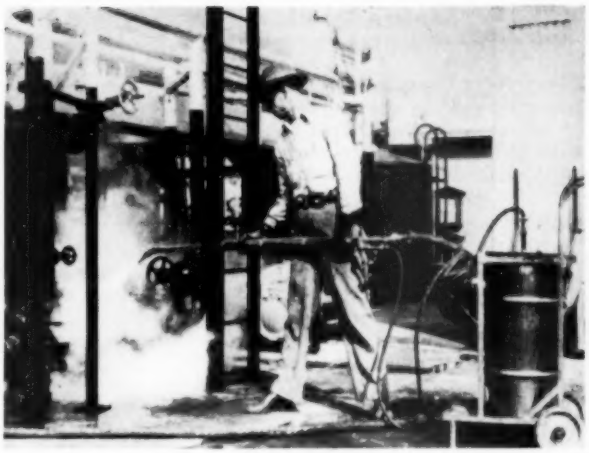

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in enforcing the conservation rules, to cooperate with the conservation agency of the adjacent state. The state agencies have jurisdiction over the conservation of the natural resources of the uplands and the inner Continental Shelf—the secretary over the outer Continental Shelf.

Much cooperation will be necessary. The states are experienced in the field of conservation. They have brought about practices during the last 25 years which have resulted in more oil and gas being conserved than was used in fighting two great world wars. They have demonstrated their ability to conserve while making plentiful oil and gas.

Cooperation between the state agencies and the secretary will not be new. The states have for years exercised this conservation jurisdiction over the federal public lands. They have promulgated the same set of rules for lands privately owned, for state laws and for federal lands. Moreover, Congress, to assist in enforcing these state rules, enacted the Connally Hot Oil Act,[19] making it a federal offense to transport in interstate commerce oil produced in violation of state law.

Many oil and gas fields will be bisected by the line dividing lands of the inner Continental Shelf from lands of the outer Continental Shelf. On the uplands where state lines have pierced a field, the state agencies, through joint hearings and consultation, have promulgated a common set of rules. The same cooperation between the federal Government and the states will result in better conservation practices.

Waste incident to the excessive storage of oil from the outer Continental Shelf must be avoided. Some states have eliminated this type of waste by confining the production to the market demand. Outer Continental Shelf oil must find a place in the market, but when it is necessary to curtail production to prevent the wasteful storage of oil, the production from the outer shelf should be reduced proportionately. Joint action on the part of the state agency and the secretary will be advisable in many instances.

Other regulations . . . The secretary can promulgate such other rules and regulations as he may deem necessary to carry out the provisions of the Outer Continental Shelf Lands Act. He may publish rules for the assignment or relinquishment of leases, for the sale of royalty oil and gas, for unitization and pooling, for drilling agreements, for the suspension of operations or production, for the reduction of rentals or royalties, for compensatory royalty agreements, for the subsurface storage of oil or gas, and for drilling easements and other easements necessary for operations or production.

Each new lease will be conditioned upon a compliance with the regulations in force on the date the lease is issued. Each lease issued by a state which is ratified by the act will be conditioned upon a compliance with the regulations issued within 90 days after the secretary determines that the lease comes within the ratification provisions of the Act.

A nonproducing lease may be canceled by the secretary for a breach of the provisions of the lease, or of the regulations, if the default continues for a period of 30 days after notice of the breach. However, the secretary's action may be reviewed by the courts. A producing lease can be canceled only by the courts.

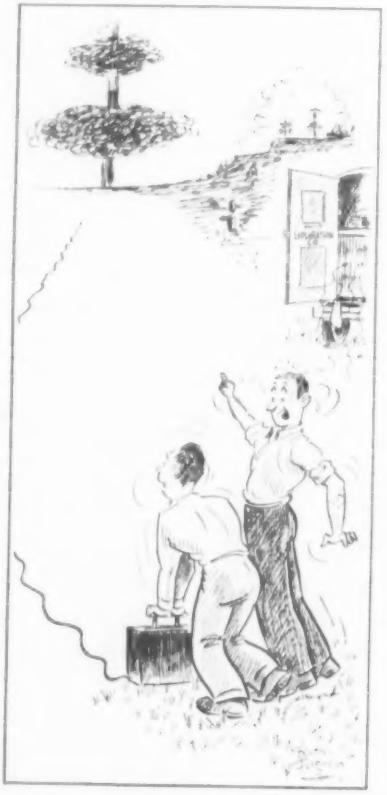
Recapitulation

This discussion has not included any of the engineering problems incident to producing oil or gas in the open sea. There are many. Some have been solved; others remain to be solved.

It should be clear from what has been said that finding and producing oil from the Continental Shelf is not the bonanza some have represented it to be. The costs will be great, the hazards even greater. Expensive shore bases, costly boats for geophysical operations, expensive drilling platforms, costly transportation of men and material, expensive communication facilities, higher insurance premiums, more men, more material, expensive standby boats, more travel time, dangerous hurricanes, high waves, costly pipe lines or barges, more regulations, uncertainties as to boundaries, etc.—these are only some of the perplexing problems in producing oil from the open sea. But they will not discourage the oil industry which is willing to spend its dollars today for the oil this nation will need 10 years hence.

However, the right governmental atmosphere will be necessary. The Government must regulate, but only to the extent necessary to protect the public interest. It should not usurp the prerogatives of management.

The Submerged Lands Act and the Outer Continental Shelf Lands Act should be interpreted and administered reasonably. They were highly controversial. Many provisions resulted from compromises—compromises made so that the oil can be developed today and made available to this nation tomorrow.



"Migosh, Joe! Where in New Mexico did you get those last charges?"

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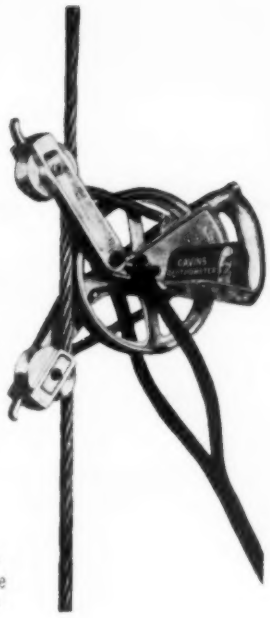

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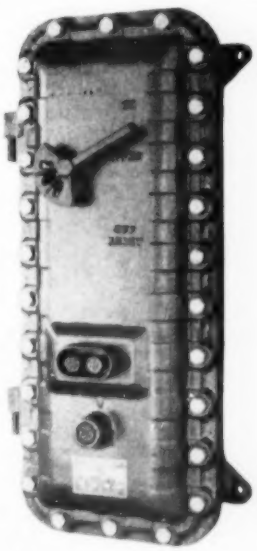

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Automatic Control of Gas Turbines

by C. R. Ingemanson, Arne Loft, and H. J. Wilt

A DETAILED description of the application of the gas turbine for gas pipe-line pumping was given by J. F. Eichelmann and J. S. Quill[1] (see also Engineering Reference Section, The Oil and Gas Journal, February 9 to March 16, inclusive). Recently the design details of the 5,000-hp. gas turbine have been presented by B. O. Buckland and D. C. Berkey[2]. The purpose of this paper is to describe the automatic control equipments for the 5,000-hp. gas turbine designed for natural-gas pipe-line pumping.

Fig. 1 shows in schematic form the components of a natural-gas pipe-line system incorporating a 5,000-hp. gas-turbine which must be controlled to place a pumping unit in or out of operation. Fig. 1 also includes the schematic gas line piping for a four-unit natural-gas pipe-line pumping station with a total rated capacity of 20,000 hp. This is the maximum contemplated for any one station at the present time.

Control devices . . . Speed responsive relays and motor-driven timing relays are the heart of the automatic control equipment for starting and stopping a gas turbine pumping unit. These relays function to control the various steps in the operating sequence.

The speed relays operate in response to the rectified output of tachometer generators coupled to the shafts of the high and low pressure turbines.

The motor-driven timing relays, which operate either directly or indirectly from speed relay signals, control such functions as turbine and duct purging, gas-compressor purging and pressuring, valve operation, and turbine cooling.

Contact multiplying auxiliary relays provide the necessary interlocking for correct sequence operation.

A pressure regulator which responds to a station discharge pressure signal controls the gas turbine speed and loading to maintain the desired station discharge pressure.

Operation sequence . . . The control circuits are arranged so that the starting signal will initiate the starting sequence of the gas-turbine pumping equipment only when all prestarting conditions have been satisfied. When the circuit breakers for the auxiliary and emergency lube oil and emergency nozzle cooling water pumps are closed, protective device trip contacts are reset and control air pressure and battery charge are normal, three green lamps are lighted indicating that starting conditions are correct.

Annunciation and alarms . . . A 36-drop annunciator together with an alarm bell and lamp provide both audible and visual warnings when an abnormal operating condition exists or when a protective device operates to shut down the turbine.

The annunciator alarms are arranged in three groups:

1. Warning only for an abnormal operating condition.
2. Warning for an abnormal operating condition with subsequent shut down if the condition persists.
3. Shut-down indication.

This arrangement provides an easy means of advising a remote dispatcher the nature of the trouble when an alarm signal is received.

Provision for operating a station siren and any additional alarm devices which may be required is included in the alarm circuits.

Remote control . . . Local operators will control the first pipe-line pumping gas-turbine equipments being installed. However, it is contemplated that the units eventually will be controlled by a remote dispatcher.

Arrangement of the automatic control circuits permits a remote dispatcher to place a unit into operation or shut it down with one start or stop signal. He also will have control of the operation of the station bypass, suction, and discharge valves.

Turbine temperature overrides . . . The load of each unit is determined by the load turbine speed control which is overridden by turbine exhaust temperature as follows:

The speed signal from the governor generator, the temperature signal from the gas-filled bulb and the called-for speed signal from the pressure regulator are fed into the fuel regulator which in turn positions the gas-control valve to supply the desired amount of fuel to the combustion chambers. Ahead of the gas-control valve is a pressure ratio valve which holds a fixed ratio between the control-valve inlet pressure and the combustion-chamber pressure, thereby limiting the required range of the gas control valve. An electrically operated stop valve is located between these two valves to shut off fuel when desired. (See Fig. 1.)

Authors are with General Electric Co. Excerpts from paper given at A.I.E.E. meeting, September 1-4, 1953, at Vancouver, B. C.

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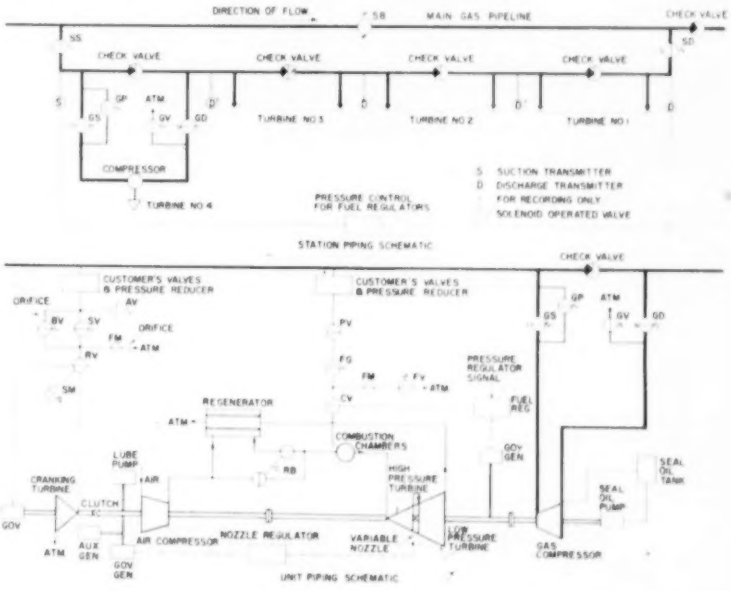

AV—Alcohol valve
BV—Starting bypass valve
CV—Gas control valve
FV—Fuel-gas stop valve
FM—Flow meter
FV—Fuel-gas vent valve
GD—Gas-compressor discharge valve
GP—Gas-compressor pressurizing valve
GS—Gas-compressor suction valve
GV—Gas-compressor vent valve
PV—Pressure ratio valve
RB—Regenerator bypass valve
RV—Starting regulating valve
SB—Station bypass valve
SD—Station discharge valve
SM—Starting mechanism
SS—Station suction valve
SV—Starting stop valve

Fig. 1—Typical piping schematic for gas turbine pumping station.

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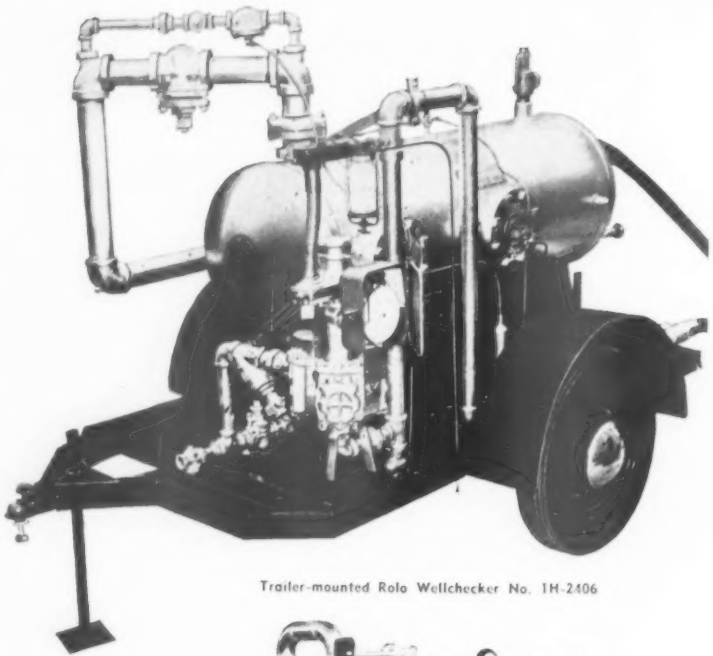

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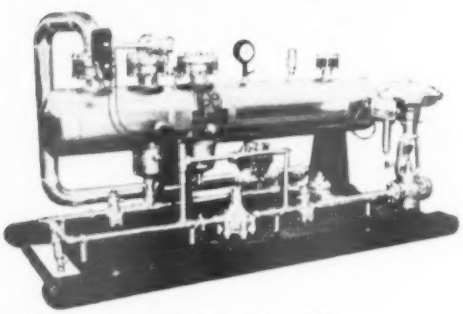

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How to Design and Evaluate Absorbers—2

by R. J. Hull and K. Raymond

THE heat and material balance and heats of absorption will be dealt with in this installment of the California Research Corp. method for calculating absorbers.

Material balance . . . The exact component material balance expression derived by Horton and Franklin for an absorber of n theoretical plates may be simplified into the following form:

$$\frac{y_{1G}V_{1G} - y_{pG}V_{pG}}{y_{1G}V_{1G} - L_o x_o/A_C} = F = \frac{A_E^{n+1} - A_E}{A_E^{n+1} - 1} \quad (1)$$

where:

y_{1G} = mole fraction of component in intake gas
y_{pG} = mole fraction of component in discharge gas
V_{1G} = moles of intake gas
V_{pG} = moles of discharge gas
x_o = mole fraction of light component in lean oil
L_o = moles of lean oil
F = fraction of component absorbed
n = number of theoretical trays

The equation is in terms of an average effective absorption factor, A_E, and includes a correction for the presence of solute in the oil fed to the absorber in terms of an absorption factor A_C. The more detailed expressions of Edmister and Horton and Franklin for the absorption factors A_E and A_C give a clue to methods of evaluating these factors in actual absorbers; however, discussion of these methods will be deferred until other phases of the design procedure have been presented.

Authors with California Research Corp., Richmond, Calif. Paper presented at the C.N.G.A. meeting, Los Angeles, October 8-9.

Heat balance . . . Simplified absorber heat balances are made by equating the products of the flow rates, specific heats, and temperature changes of the process streams to the heat evolved by the absorption of components from the intake gas. Heat losses or gains due to differences between column average temperature and ambient temperatures should also be included in the heat balance. With intercooled absorbers, the intercooler duty is also included in the heat balance. The remainder of this study neglects the use of intercoolers. However, the methods herein may be used in intercooler justification and location studies.

The heat-balance expression is as follows:

$$W_{LO}Cp_{LO}(T_{RO} - T_{LO}) + W_{DG}Cp_{DG}(T_{DG} - T_{LO}) + W_S Cp_S (T_{RO} - T_{LO}) = \Delta H_S - 0.024\,UA\,(T_{AV} - T_{AMB}) \quad (2)$$

where:

W = rate of flow, M. lb. per day
Cp = specific heat, B.t.u./lb./°F.
T = temperature, °F.
U = heat-transfer coefficient between absorber outside surface and the atmosphere, B.t.u./sq. ft./°F./hr. Normally use 3.0 B.t.u./sq. ft./°F./hr.
A = area of outside surface of absorber, sq. ft.
ΔH = total heat of absorption of absorbed components, M. B.t.u./day with reference subscripts:
IG for intake gas
DG for discharge gas
LO for lean oil
RO for rich oil
S for total shrinkage
AV for arithmetic average
AMB for ambient

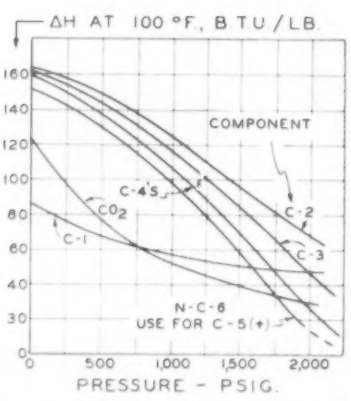

Fig. 1—Smoothed values of component heats of absorption.

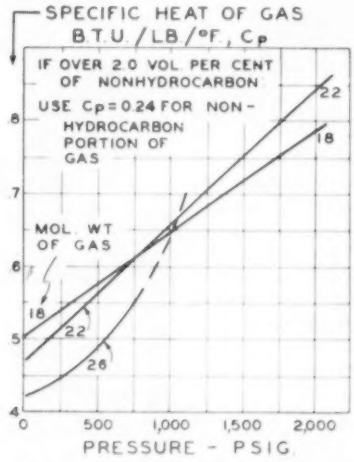

Fig. 2—Specific heat values for various natural gases.

Smoothed values of component heats of absorption are shown on Fig. 1. These values were derived from the respective component equilibrium charts by use of Equation 3:

$$\Delta H = R\,M\,[(T_1 T_2)/(T_2 - T_1)]\ln K_2/K_1 \quad (3)$$

where:

ΔH = heat of absorption, B.t.u./lb. of component at average temperature between T_1 and T_2
T_1, T_2 = absolute temperature, °R. Temperatures used were 540° R. (80° F.) and 580° R. (120° F.)
K_1, K_2 = equilibrium constants corresponding to T_1 and T_2
R = universal gas constant, B.t.u./lb. mole/°F.
M = molecular weight of component, lb./lb. mole

The H values vary somewhat with temperature, and if the average temperature of absorption is outside the 80°-120° F. range, values should be calculated directly from the equation.

Actual total heats of absorption based on a large number of experimental absorber heat and material balances were found to be generally in very good agreement with computed total heats of absorption based on component heats of absorption read from Fig. 1. The largest deviations were with very low-pressure absorbers where the weight ratio of lean oil to intake gas is very high. In this range, total heats of absorption computed from test data are very sensitive to inaccuracies in temperature measurements.

Specific heat values for various natural gases are shown on Fig. 2. These values were derived from the enthalpy-entropy diagrams of G. G. Brown.[1] Specific heat values used for lean oil and total shrinkage are respectively 0.50 and 0.65 B.t.u./lb./°F.

Reference

1. Brown, G. G., N.G.S.M.A. Engineering Data Book, 1951 edition, pp. 86-92.

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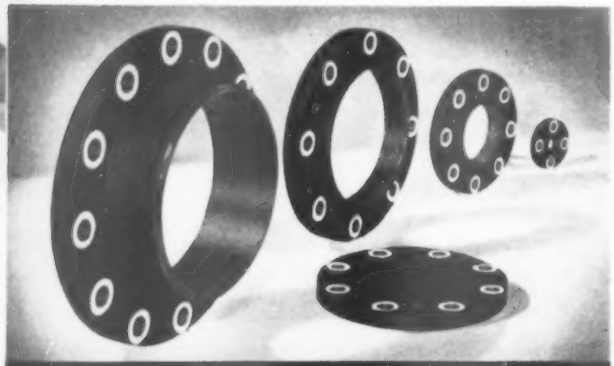

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Control Methods in Boiler Feed-Water Treatment—1

by E. W. Ellis and H. E. Carlson

MORE trouble in boiler operation can be caused by inadequate or no water treatment than by any other factor.

Of course, no one attempts to operate a high-pressure boiler plant at, say, 450 psi. or higher, without proper feed-water treatment. But the authors have observed many boiler plants, including some refinery steam plants, operating at 100 to 250-psi. pressure where feed-water treatment was carried out in a haphazard manner with inadequate or no systematic testing and control program in effect. Such practice invariably resulted in scale accumulation or corrosion, or both.

Cities Service treating . . . A few years ago, a hot lime-soda and hot phosphate treating system was installed at the Cities Service Oil Co., East Chicago, Ind., refinery, which has been eminently successful in producing deaerated feed water of very low hardness. The hardness consistently runs less than 1 p.p.m. calcium carbonate. The original installation included only the lime-soda softener, by means of which hardness was reduced to 5 to 6 p.p.m. by considerable overtreating.

At that time, disodium phosphate was periodically "slugged" into each boiler feed line about a foot from the boiler steam drum. Considerable difficulty was encountered with feed-line deposits even in the short length of line between the point of phosphate injection and the drum. Since adding the hot phosphate treater, no feed-line deposits have occurred, and feed water of very low hardness has been produced continuously with practically no interruption other than an occasional failure of a timing mechanism. Boilers are removed from service annually for inspection and are always found to be completely free from scale, corrosion, and pitting.

Authors with Cities Service Oil Co., East Chicago, Ind.

Water Treating System

Only a brief description of the treating system itself will be presented. Most of the subject matter of this Refiner's Notebook series will consist of control methods, (to be given in following installments) which in the opinion of the authors, have been largely responsible for the success of the treating processes.

At East Chicago . . . About 1,000,000 gal. per day of raw Lake Michigan water is treated successively by lime and soda ash plus sodium aluminate in one sedimentation tank, and anhydrous disodium phosphate in another tank in series. As the feed water and chemicals enter the lime-soda softener, they are sprayed into an atmosphere of live steam which heats the mixture to about 218° F. for liberating dissolved oxygen and carbon dioxide. The deaeration is sufficiently effective that no oxygen scavengers, such as sodium sulfite, have been found necessary. A blanket of steam is also maintained above the water in the phosphate softener. Liberated gases from the water are swept out of the system through a vent condenser by a moderately strong flow of steam. The amount of escaping steam is controlled by the amount of raw, cold water allowed to go through the vent condenser tubes.

Hardness reduction . . . This is from about 140 to approximately 10 p.p.m. calcium carbonate in the lime-soda softener with the aid of sodium aluminate as a coagulant for the sludge. The sludge consists of fluffy magnesium hydroxide and calcium carbonate. The water, which has settled fairly clear by the time it leaves the softener, enters the top of the phosphate softener with disodium phosphate. In both softeners, the water enters the top of the vessel with chemicals, flows downward through an inner cylinder, which extends to the top of the cone bottom of the softener, and then flows upward in the annular space between the inner cylinder and the outer shell.

The phosphate softener effluent flows to anthrafilt filters from which perfectly clear, soft, deaerated water is picked up by boiler feed pumps for delivery to seven boilers in the main steam plant and also to five waste-heat steam generators at the fluid catalytic cracking and delayed coking units. Chemicals are fed to the softeners in liquid suspension or solution, the flows of which are proportional to the volume of raw feed water entering the system.

Orifice Meter Actuates Timing

An orifice meter which measures the feed water actuates timing mechanisms which control the flow of chemicals to each softener. Hydrated lime is kept in suspension by means of a mechanical stirrer, and sodium aluminate is added to the lime slurry at the rate of 10 per cent of the weight of hydrated lime. Soda ash, disodium phosphate, and organic sludge conditioner are made up by weight in separate solutions with steam condensate. The organic sludge conditioner is added to the suction of the boiler feed pumps. Hydrated lime and soda ash are purchased in bulk car lots and unloaded by suction into elevated storage tanks from which they flow by gravity onto scales below. Scale hoppers are constructed so that chemicals can be transferred to the proper solution or suspension tank below by means of a screw conveyor. All other chemicals are purchased in bags and made up in solution form as required.

An important adjunct to the lime-soda treatment is the recirculation of a portion of the sludge from the cone bottom of the vessel, back to the top where it mixes with incoming chemicals and raw lake water. The recirculated sludge materially improves the effectiveness of lime-soda-sodium aluminate treatment.

A message of importance to companies faced with a sulphuric acid disposal problem

As an additional service to users of sulphuric acid, Consolidated Chemical Industries Inc. is now prepared to enter into contracts to take a customer's sludge acid as well as supply new acid.

Users of this service are completely relieved of their sludge disposal problems. There is no separation, concentration or burning required. Customers simply load the spent acid into tank cars and return them to us. This is especially important because old methods of burning sludge and releasing SO_2 into the air are rapidly becoming unacceptable.

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Boiler Control at Pampa Plant of Celanese

THE control system used for the steam boilers at the Pampa plant of Celanese Corp. provides for unusually efficient operation at all loads within the capacity of the installation. There are three boilers controlled by a master pressure controller. Instrumentation setup for one boiler is shown in Fig. 1.

Flow-control override . . . The master pressure controller (MPRC) actuates the set points on three indicating flow controllers (FIC), one for each boiler. Each FIC positions the governor on the forced-draft fan providing combustion air for each boiler. Each FIC operates in response to steam flow from each boiler.

The set pointer of the FIC's can be moved to any position from zero to full rated boiler capacity but not beyond. Hence, regardless of the demands of the system no boiler will be overloaded. (If on the other hand the MPRC operated from an air input directly the boilers could be pushed up above capacity at any time when unusual loads were encountered.)

Combustion control . . . It is assumed that the air output of the fan is a straight-line function with speed. A speed transmitter, which actuates the set point on the fuel-gas flow controller, is connected to the fan. Thus, if fan speed varies, gas flow is adjusted accordingly.

This method of controlling fuel-air ratio was selected on the basis of safe operation. In case of combustion air failure, air-fuel ratio is maintained and proper combustion continues. (If the gas were leading, gas would continue to flow on air failure, with possibility of explosion.)

Furnace draft . . . It is important in combustion control that the pressure on the firebox fluctuate very little. Consequently, in the Celanese control setup, the pressure in the combustion chamber is adjusted by a recording pressure controller operating the damper on the inlet to the induced draft fan.

Level control . . . Primary control is provided by a steam-water ratio flow controller so that boiler feed water continually follows steam make. Level is measured by a differential-pressure cell. As level varies, the level-controller output pressure varies and ratio of water to steam flow is changed to maintain the water level at its assigned value with small deviations. Instruments for the Celanese Pampa boiler plant were furnished by Foxboro Co.

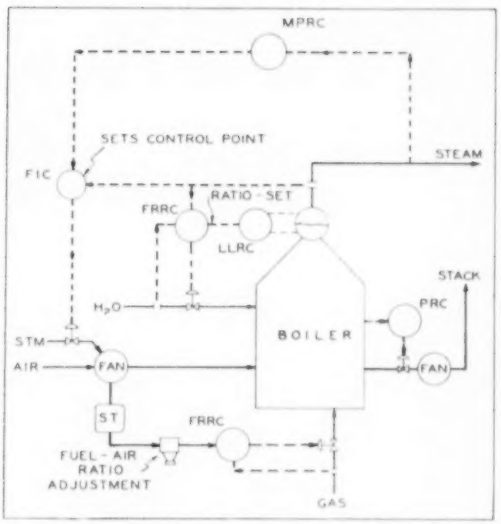
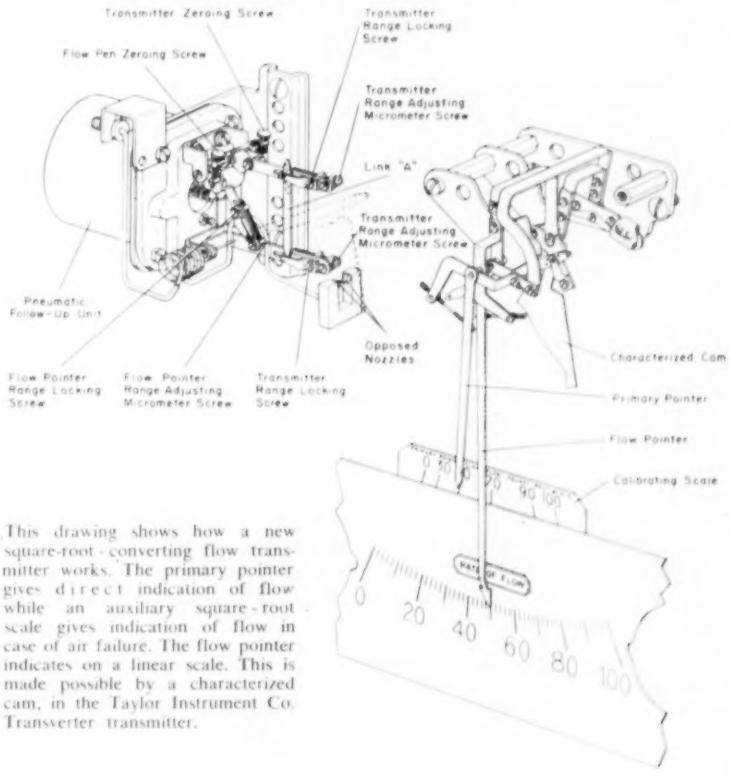


Fig. 1—Schematic diagram of boiler-control system for the Pampa, Tex., plant of Celanese Corp.

Converting Square Root Into Linear Function



This drawing shows how a new square-root-converting flow transmitter works. The primary pointer gives direct indication of flow while an auxiliary square-root scale gives indication of flow in case of air failure. The flow pointer indicates on a linear scale. This is made possible by a characterized cam, in the Taylor Instrument Co. Transverter transmitter.

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ELECTRIC LOGGING—14

The Three-Electrode Device and Its Response Opposite Thick Beds

by R. I. Martin

THE original logging device described by the Schlumberger brothers was a three-electrode device.

Referring to Fig. 2 of Installment 7, one pickup electrode M might be placed at a distance r from the current electrode and a second, N placed at a distance r + dr. In this case the potential difference dV between the electrodes is measured, and the resistivity computed as follows:

$$V \text{ (at M)} = RI/4\pi \cdot 1/AM$$

$$V \text{ (at N)} = RI/4\pi \cdot 1/AN$$

$$dV = V \text{ (at M)} - V \text{ (at N)}$$

$$= RI/4\pi \,(1/AM - 1/AN)$$

$$= RI/4\pi \,(AN - AM)/AM(AN)$$

$$= RI/4\pi \cdot MN/(AO)^2$$

where O is the midpoint of MN and AM is large compared with MN.

Under ideal conditions the resistivity so measured will be identical with that measured by the first two methods. In practice the response of the three-electrode device is rather different from that of the mono and two-electrode devices. Opposite thick beds it gives asymmetrical peaks but its advantages are: (1) A greater depth of investigation with less averaging effect in proportion to its spacing than is found with two-electrode devices. (2) A positive response to beds thinner than the electrode spacing.

Fig. 1 is useful in explaining qualitatively why the characteristic triangular peaks are obtained opposite thick beds. The resistivity R_T of the bed is 10 ohm-m. and the resistivity of the shale R_s is 1 ohm-m. The bed is 50 ft. thick while the shales are considerably thicker. The electrode spacing AO is 18 ft. and the pickup span MN is so small that its length may be neglected in comparison with AO. In this case the effect of a bore hole filled with drilling mud is neglected.

At the measuring position (a) about 50 ft. above the upper contact, the current electrode A is so far from the bed that the current lines are not distorted appreciably in the vicinity of M and N. This is illustrated by the straight radial current vectors radiating from A. For practical purposes the apparent resistivity measured at (a) is equal to R_s. This reading is plotted directly opposite O, the midpoint of MN.

At point (b), a short distance above the upper boundary, part of the current is deflected upwards by the resistant bed. This condition is shown by the curvature now given to the current vectors. Because of this low current density, the potential difference between M and N is smaller so that the apparent resistivity is also smaller. Its value is about one-half that of the true resistivity.

When the pickup electrodes are inside the resistant bed, as in position (c), even less current reaches them. This again results in a lower apparent resistivity; however, the medium surrounding the pickup electrodes is now more resistant than before so that the actual potential difference measured is now greater, even though the current reaching them is lower. The apparent resistivity is now of the order of one-fourth of the true resistivity R_T, that is, 2.5 ohm-m.

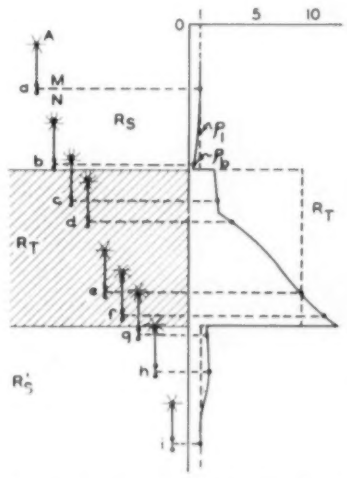

Fig. 1—Response of the three-electrode device opposite thick resistant bed. From "Electric Well Logging," a copyrighted manual by Herbert Guyod.

The next point of interest is at (d) where the current electrode is just inside the upper boundary. At this position, there is less resistant material below the current electrode than there was formerly, and the upward repulsion is less than before. The apparent resistivity may be equal to four-tenths of the true resistivity, or 4 ohm-m.

From this point onward there will be less and less resistant material below current electrode A, and more and more above it. The upward current repulsion will decrease gradually.

When the current electrode is at the exact center of the bed the resistivity distribution will be the same above and below. The current vectors are again straight lines. For this unique position (e) the apparent resistivity equals the true resistivity. This is the only point on the whole log where this occurs.

If the electrodes are lowered several feet to (f) there will be more resistant material above A than below it. Consequently the current will be repulsed downwards. The condition obtaining at (d) for example is reversed, and the amount of current flowing past the pickup electrodes is increased so that it is larger than normal. Consequently the apparent resistivity will be larger than the true resistivity—perhaps 20 per cent larger, that is 12 ohm-m.

When the current electrodes leave the resistant bed as at (g) the repulsion is relatively large and the apparent resistivity may be 60 per cent greater. However, the pickup electrodes are now situated in the medium of lower resistivity so that the potential difference measured is smaller than before. As stated, it might be 60 per cent greater than the true resistivity of the shale, or 1.6 ohm-m.

The repulsion becomes larger and reaches a maximum when the current electrode is at the lower boundary. For this position (h) the apparent resistivity may be 75 per cent greater than the true resistivity or 1.75 ohm-m.

Position (i) is analogous to position (a). Normal current distribution again prevails and the apparent resistivity is equal to the true resistivity.

Author is assistant professor of petroleum engineering, Missouri School of Mines and Metallurgy.

Relationship Between Characterization Factor and Viscosity Index

by W. L. Nelson
Technical Editor

We are considering several crude oils for lubricating-oil manufacture. Is there any way that we can judge the quality of the lubricating oil that can be produced from the general properties of the crude oil?—S.G.M.

Although it is usually believed that raw paraffinic or high-characterization-factor crude oils contain lubricating oils of high viscosity index, quite the opposite may be true if the raw lube stock contains large amounts of wax. This is forcefully illustrated by the data of Dale Tull (master's degree thesis, University of Tulsa, "A Study of High Viscosity Index Oils," 1953) on Guario Venezuelan crude oil:

Fraction boiling range °F.	Viscosity index Before dewaxing*	After dewaxing*
712-732	115	71
732-744	123	78
744-754	143	54
754-792	149	57
792-853	162	62

*Dewaxing to a pour point of 5° F.

Data on San Roque Venezuelan oil (700°-900° F. boiling range) is even a more forceful illustration:

	Viscosity index Before dewaxing	After dewaxing
A.P.I. gravity	34.1	20.8
Character factor	12.44	11.44
Pour point, °F.	115	3
Viscosity at 100° F.	15.98 cst.	33.6 cst.
Viscosity index	136	28
Per cent wax	55.6	zero

However, the behavior of these oils is unusual because of their very high wax contents. Conventional United States oils contain less wax and accordingly the characterization factor of the waxy lube stock is a fairly good indication of the properties of the dewaxed lubricating oil.

Fig. 1 is a plot of the general relationship between the characterization factor and viscosity index of lubricating-oil fractions. The only data heretofore available in the literature are indicated by the dashed line of Dean and Davis (Chem. Met. Engineering, Vol. 36, p. 618, 1929). The triangle points are from the two books published by the Ministry of Mines and Hydrocarbons (Ministerio de Minas e Hidrocarburos) of Caracas, Venezuela, entitled, "Venezuelan Crude Oils" and "Venezuelan and Other World Crude Oils." Most of these points are for Venezuelan oils but other oils are also represented. The circle points are those of the Dale Tull experiments for both waxy and dewaxed stocks. Note that the relationship appears to apply equally well to stocks that have been dewaxed and those that have not been dewaxed.

As pointed out earlier herein, Fig. 1 must be used with great care because dewaxing of a waxy stock may result in a great lowering of the characterization factor and viscosity index.

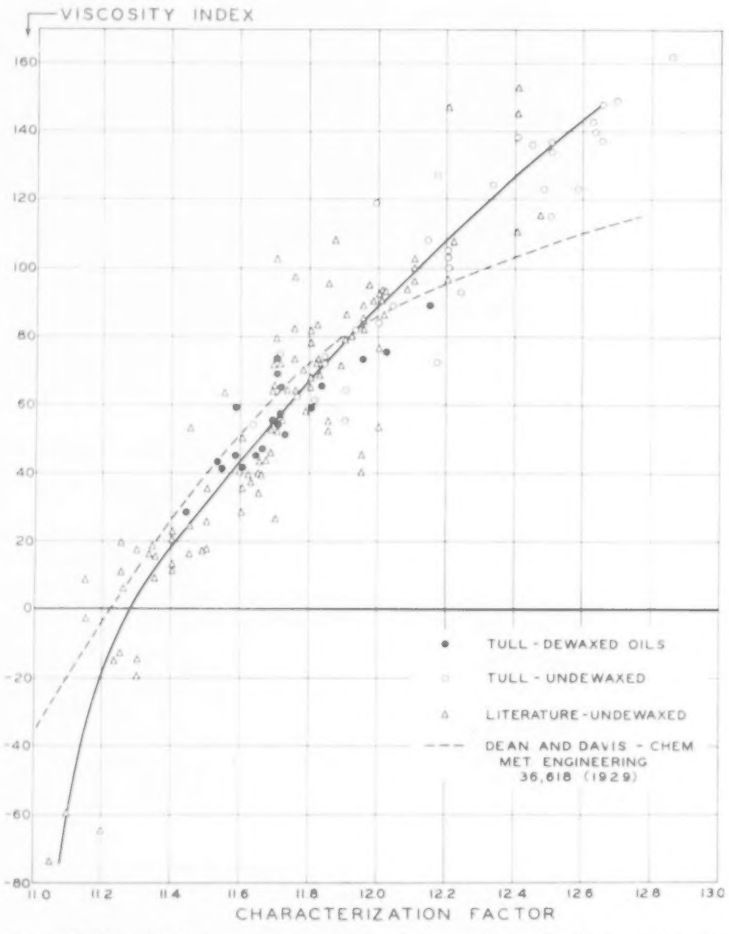

Fig. 1—Relationship between characterization factor and viscosity index, mainly for Venezuelan stocks.

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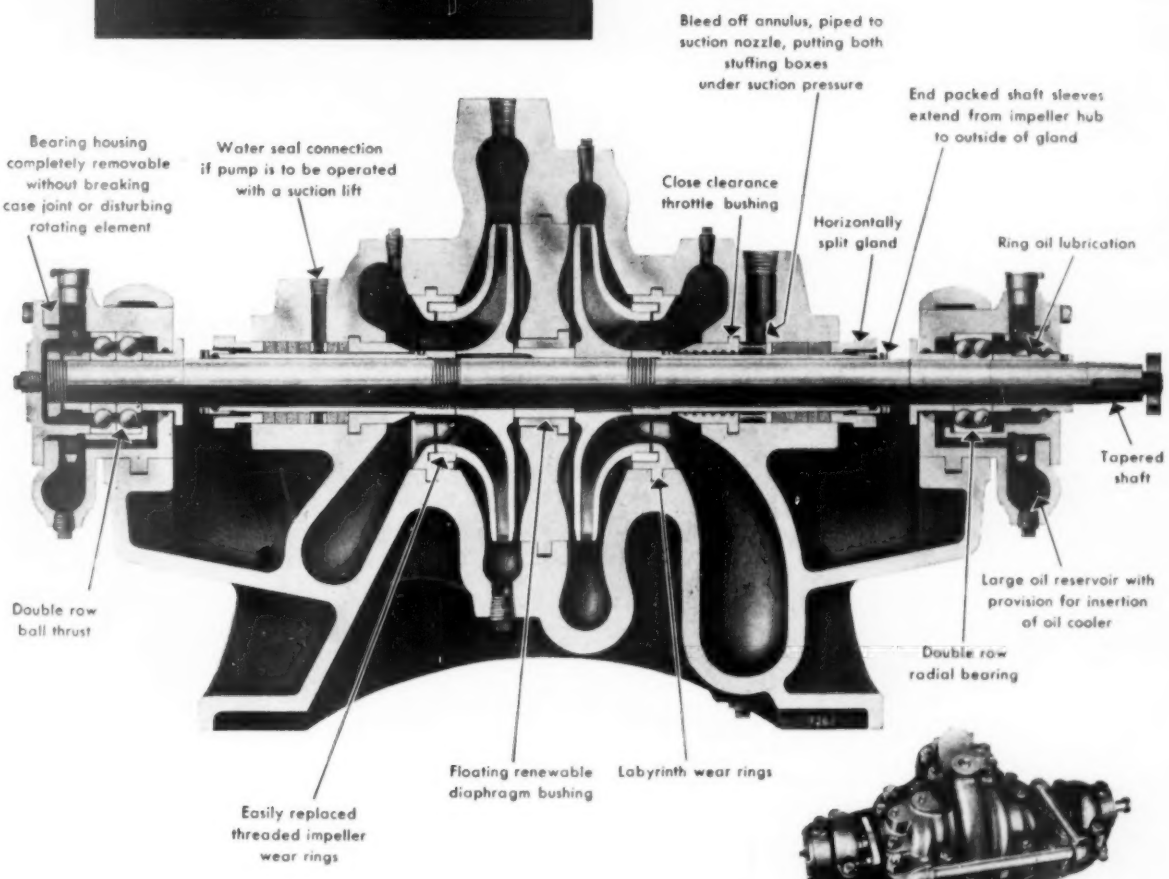
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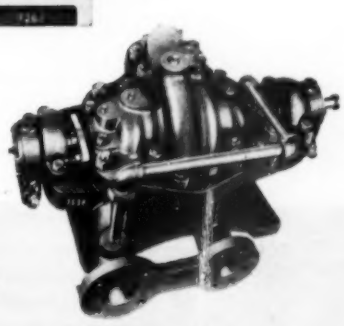

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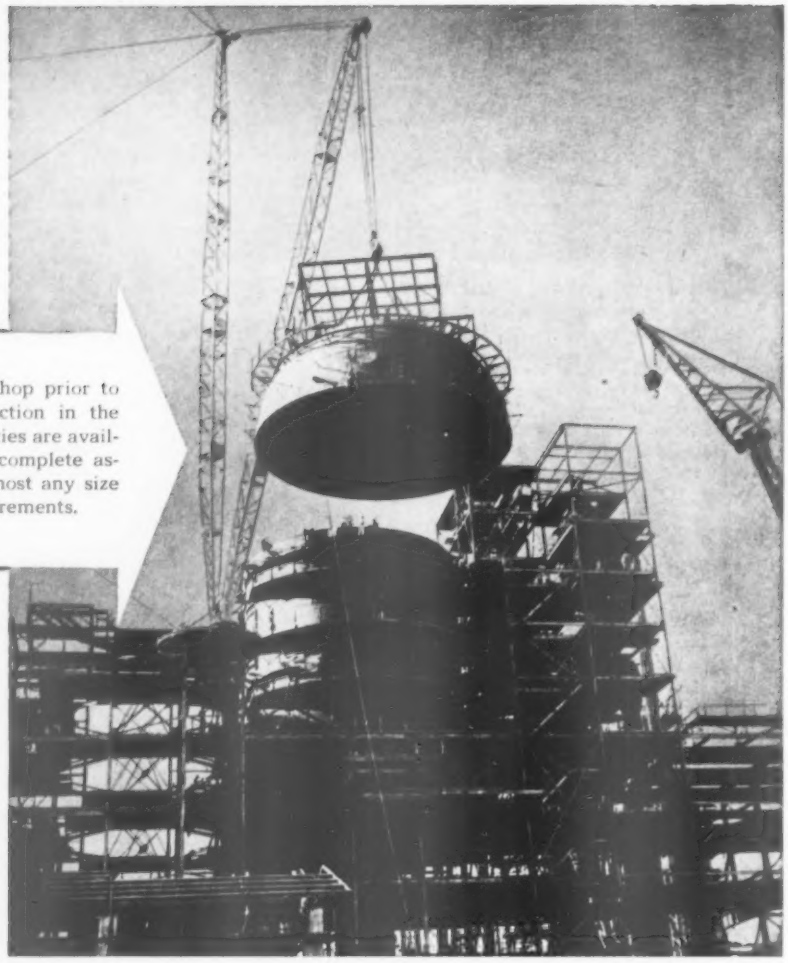

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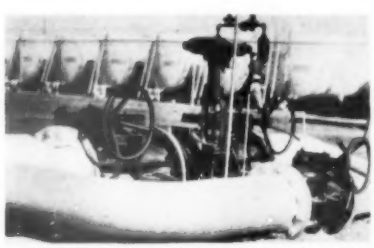

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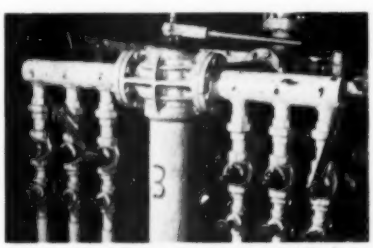

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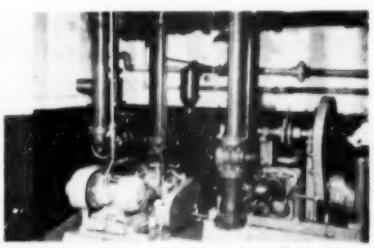

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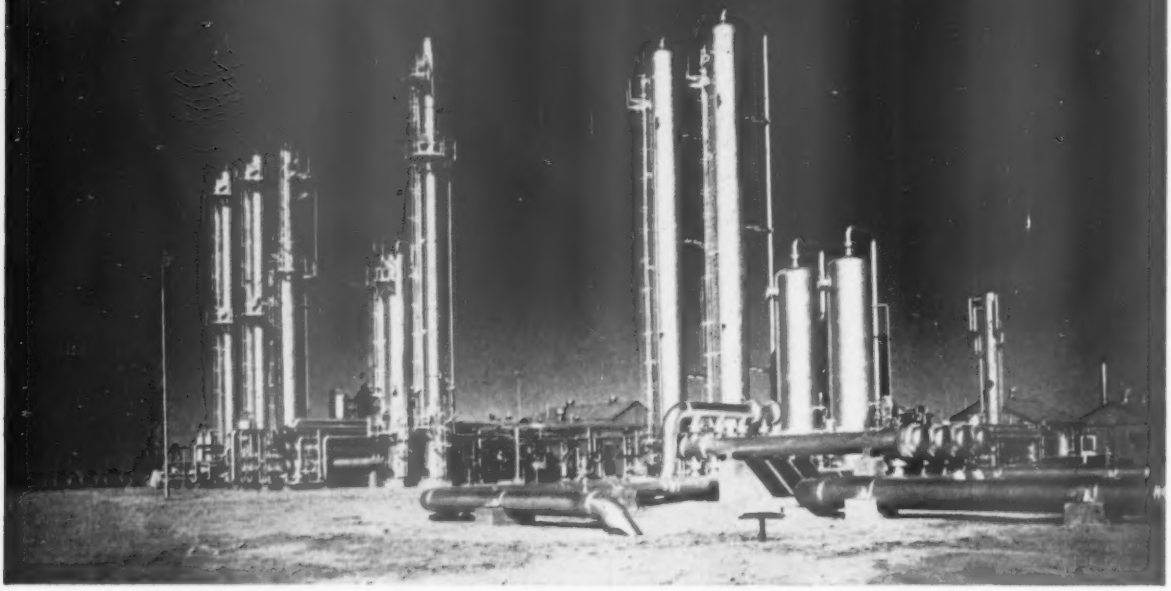

The modern gas industry requires a lot of old-fashioned know-how. It takes a company like Pritchard—with more than a quarter of a century's experience—to understand the complexities of modern technology . . . to keep pace with the many new design, engineering and construction developments in the gas processing field. All that Pritchard has learned, all the exceptional skills and techniques acquired during those long years of proved ability, make possible for you new accomplishments today and tomorrow.

Without that vital background, Pritchard would not be so uniquely qualified to provide modern, efficient processing facilities like the natural gasoline recovery plant shown here which was designed and built by Pritchard for the Hugoton Production Company of Ulysses, Kansas. This plant handles a daily capacity of 90,000,000 SCF.

Why don't you depend on Pritchard for complete "drawing board to on stream" service? Your inquiry will receive complete and immediate attention.

Industry's Partner for Progress

Serving the Gas, Power, Petroleum and Chemical Industries

J.F. Pritchard & Co.

ENGINEERS • CONSTRUCTORS • MANUFACTURERS

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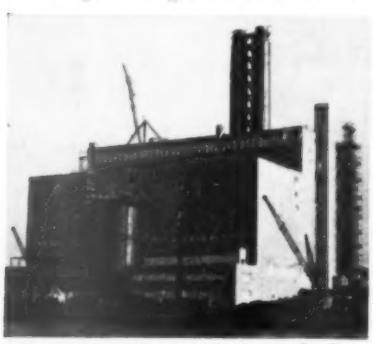
HERE'S ONE of more than 6260 ANACONDA Ambraloy-927* Tubes going into Consolidated Edison's new condenser.

Con Edison chooses Aluminum Brass for condenser tubes in new power plant

The Consolidated Edison Company's new power plant in Astoria, N. Y., will house 6 generating units. Unit #2, having a 160,000-kw generator, will be put on the line in the Spring of 1954. The condenser serving this unit has cooling surface area of 105,000 sq. ft. Tubes—15,450 of them—are Aluminum Brass, ¾" O.D., #18BWG, 30 ft. long. About half were supplied by Anaconda.



LOCATED IN ASTORIA, QUEENS, on the East River, Con Edison's new plant will mean better-than-ever electrical service for New York City.

ANACONDA Ambraloy-927* (aluminum brass) is one of the most durable tube alloys available at a moderate cost. It gives excellent service in both clean and polluted sea water and has largely replaced Admiralty along the U. S. seacoast. It is used not only in main condensers, but also in auxiliary coolers for lubricating oil, transformer oil, hydrogen and air.

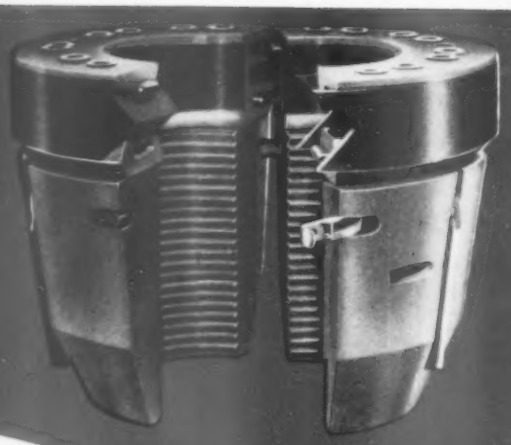
Anaconda supplies Con Edison — which insists upon the best equipment available — with condenser tubes and tube sheets for many of their power plants. Whatever alloy best fits *your* operating needs, choose it from the extensive line of ANACONDA Alloys for tube and tube sheets. Our Technical Department will be glad to analyze your tube performance problems at no cost. Free Publication B-2, "ANACONDA Tubes and Plates for Condensers and Heat Exchangers," will be sent on request. Write: *The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.* 6312

*U.S. Patent No. 2,062,682 (ORIG.)

ANACONDA®

Tubes and plates for condensers and heat exchangers • welding rods • American Flexible Metal Hose and Tubing • American Vibration Eliminators

RECTOR SLIP PACKOFF ASSEMBLY



for Type RH Casing Head

...lowers through blowout preventer

...seals before preventer is removed

...sets and seals simultaneously

The Type "SP" Slip Packoff Assembly gives the operator everything desired in a casing head setting and sealing arrangement. It provides the safety and convenience of setting casing without removing the Blowout Preventer, plus the permanent, leak-proof advantages of the famous Rector metal-to-metal seal . . . a good weld, plus API Ring Gasket.

The Type "SP" Slip Packoff is wrapped around the pipe, latched and lowered through the Blowout Preventer into the seat in the Rector RH Casing Head. Special floating ribs in the slip segments contact the casing head bowl and hold the slips in position to assure positive engagement of slip teeth with the casing as it is lowered for final setting.

The compressible sealing element directly above the slips has a bottom retainer ring attached to the ribs. An upper retaining ring is attached to the slips by Allen Head Bolts. The ribs hold the bottom retainer ring in a fixed position. As the slips move downward with the pipe, the sealing element is compressed by the upper retainer ring, which moves downward with the slips. This effects a positive seal at the same time the setting is made and without removing Blowout equipment.

Rector Type "RH" Casing Head with Type "SP" Slip Packoff in position. Standard Rector Welding Ring and API ring gasket are used in the usual manner to provide the famous Rector metal-to-metal seal.

Ask your Rector Representative or Supply Store about the new Type "SP" Slip Packoff Assembly. It is available for our Type RH Casing Heads in all popular pipe sizes.

RECTOR WELL EQUIPMENT COMPANY INC

★ MAKING THE OIL INDUSTRY SAFER ★

1100 NORTH COMMERCE ST FORT WORTH, TEXAS

Houston Plant: 2215 Commerce St.

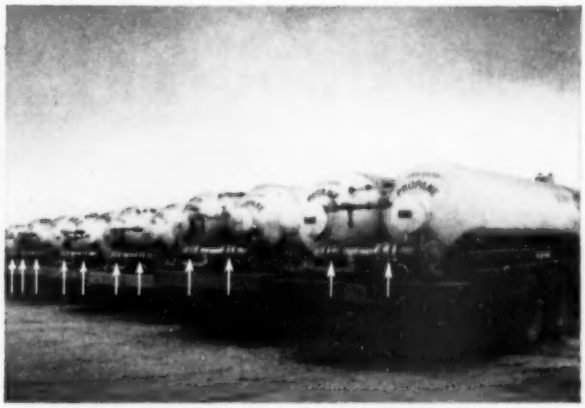
REPRESENTATIVES IN ALL ACTIVE FIELDS

ASSOCIATION OF WELL HEAD EQUIPMENT MANUFACTURERS CERTIFIED

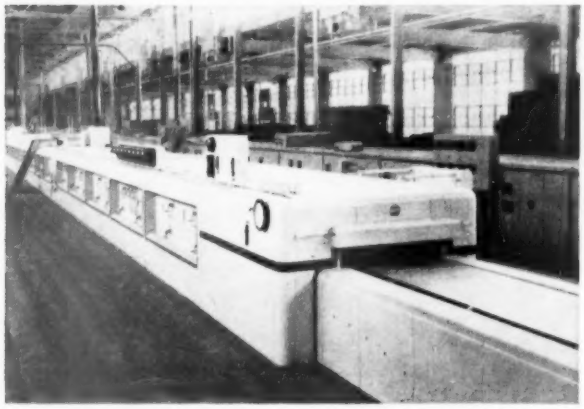
RECTORHEAD RECTOR DOUBORE CEMENTING METHOD RECTORSEAL

Do you need a LEAKPROOF VALVE?

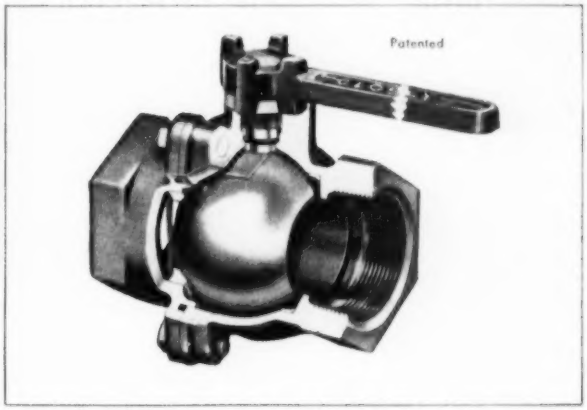
Leakproof in a Propane Plant, where hazards are high and protection is important. Here Rockwood Ball Valves are "far ahead of any others we have used," to quote the maintenance engineer.



Leakproof on LP Gas Trucks, where a whole fleet of trucks carries flammable bottle gas. Operator of fleet reports longer life for valves and generally lower costs since standardizing on Rockwood Ball Valves.



Leakproof in a Bakery where escaping gas and gas odor are a hazard. Rockwood Ball Valves, used in the ovens above, hold tight despite adjustment at various times to control flow of natural gas.



Leakproof for Longer Time — because Rockwood Ball Valves are designed to operate under the roughest and most grueling of conditions. They pay for themselves over and over wherever they are in service.

Plus these other exclusive features

Full Round Flow — assuring fast, efficient operation, less friction loss.

Quick Opening and Closing — needs only ¼ turn even under full pressure.

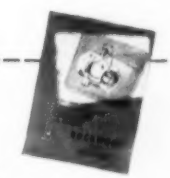
Resists Wear Longer — Chrome-plated bronze ball stands up under abrasion, pitting and scratching.

Rockwood Ball Valves are used in all types of applications throughout the petroleum field. Perform with trouble-free continuity. Longer time between replacements, less maintenance on the job. Comes in all pipe sizes. Tested and listed by Underwriters' Laboratories, Inc. The coupon will bring you complete information.

ROCKWOOD

THE FLOW IS AS ROUND AS THE PIPE ITSELF

***FULL-FLOW* BALL VALVES**



ROCKWOOD
SPRINKLER COMPANY
104 Harlow Street, Worcester 5, Mass.

Send me illustrated folder V-4 on Rockwood Full-Flow Ball Valves.

Name.....

Title.....

Company.....

City.....

Zone..... State.....

REPORT: What

REPUBLIC'S NEW SEAMLESS MILL,
CHICAGO, ILLINOIS
MAKING SHIPMENTS TO
OIL FIELDS ANYWHERE
Hudson Bay
N
W
E
S
Atlantic Ocean
Gulf of Mexico
Pacific Ocean

Republic is doing to ease the Casing and Tubing squeeze

A NEW MILL—To help the oil and gas industries step up "new well" figures, Republic built and is now operating a new seamless tube mill.

TOP QUALITY—The latest developments in equipment and techniques—plus rigid control from ore to finished product—assures seamless products second to none.

CAPACITY—With 180,000 tons annual capacity, this new mill will add substantially to the supply of seamless casing and tubing.

LOCATION—At Chicago, Illinois—on the Calumet River which flows into the Illinois River and then into the Mississippi. Thus, the location permits prompt delivery to the oil and gas fields by river barge, as well as by rail or truck.

SIZES AND GRADES—Seamless casing and tubing sizes range from 2⅜" through 9⅝", and in grades through N-80.

ELECTRIC WELD, TOO—Republic will continue to produce its time-proved electric weld casing and tubing—now widely used throughout the oil and gas industries—in sizes 2⅜" to 13⅜", grades H-40 and J-55.

ONE SOURCE—Now, when you order casing and tubing, consider Republic's quality and shipping facilities—plus the fact that you can get *both* seamless and electric weld products from *one source*.

For further information, contact your nearest Republic Sales Office—or write to:

● *Would you like to take a quick picture trip through Republic's new seamless mill? Then write for this new 24-page booklet—No. Adv-595.*

REPUBLIC STEEL CORPORATION
GENERAL OFFICES: CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York 17, N.Y.

Republic
REPUBLIC STEEL
CASING AND TUBING
Electric Weld and Seamless

Other Republic Products include Line Pipe—Carbon, Alloy and Stainless Steels—Upson Studs, Bolts and Nuts—ELECTRUNITE Heat Exchanger Tubes

Oh, I see

At Stanolind Oil & Gas Company's Stano plant in Ulysses, Kansas, these 12-inch OIC gate and check valves are in service in the plant cooling water system.

. . . you, too, can depend on OIC valves

These OIC Valves typify OIC responsibility. Petroleum companies rely on them to regulate flow precisely and efficiently. OIC safeguards this confidence by engineering and manufacturing valves that fit their job exactly and perform according to the most rigid specifications.

Write for catalog information or engineering assistance.

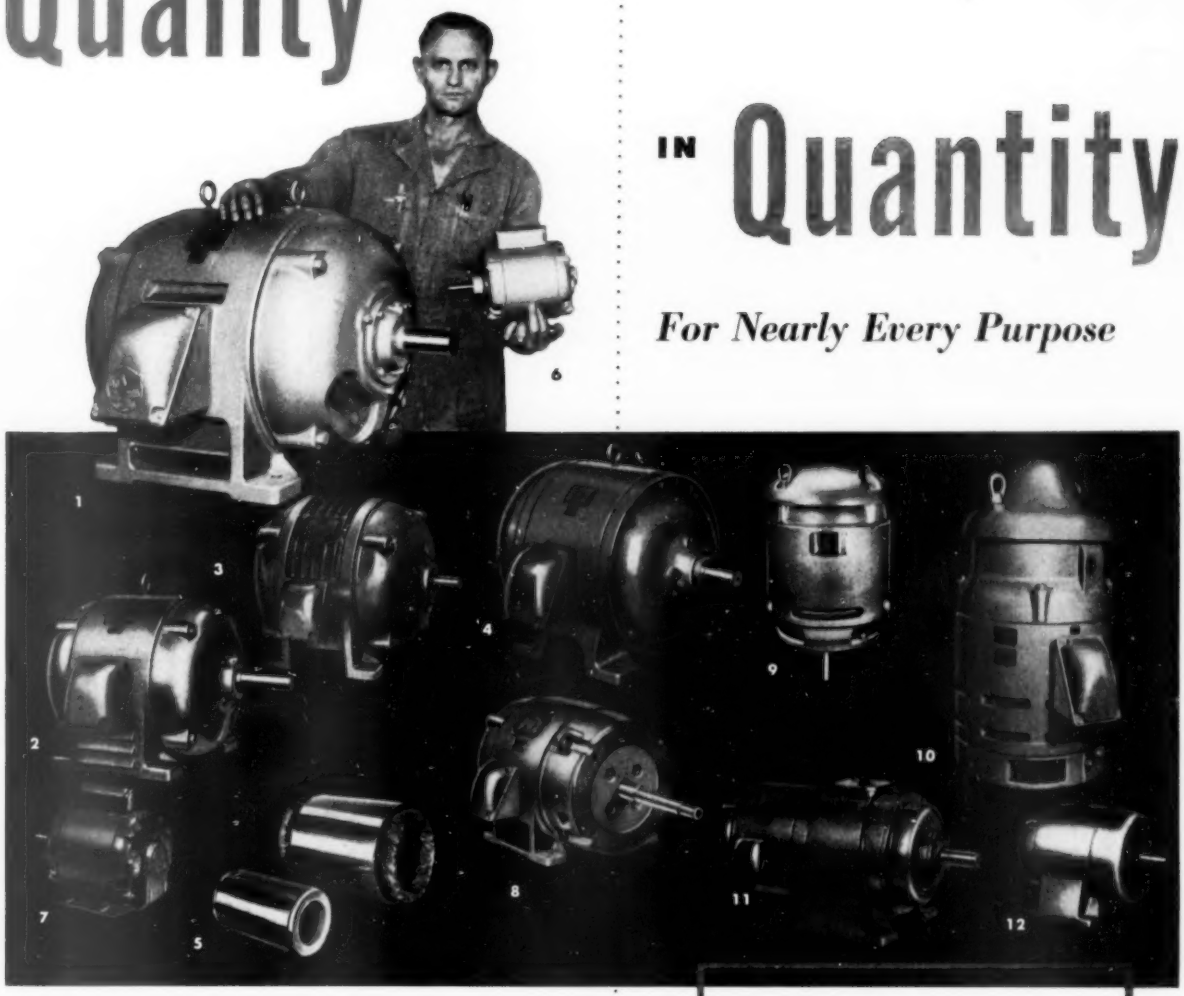
THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO

OIC FOUNDED 1883

VALVES | **BRONZE & IRON, FORGED & CAST STEEL, LUBRICATED PLUG VALVES**

Quality MOTORS IN Quantity

For Nearly Every Purpose



Mechanical Types: Drip-proof (1); Splash-proof (2); Totally Enclosed Non-Ventilated (3); Totally Enclosed Fan-Cooled (4); Rotors and Stators (5); Rigid Base (6); Resilient Base (7); Flanged (8); Vertical Solid Shaft (9); Vertical Hollow Shaft (10); Gear Motor (11); Special Purpose (12).

Electrical Types: Fractional H.P. ¼ to ¾. Integral H.P. 1 through 500. Single phase. Polyphase. Normal Slip. High Slip. Normal Torque. High Torque.

A. O. SMITH offers you quality motors in a wide range of types and sizes from ⅓ H.P. to 500 H.P. Proof of quality is demonstrated daily by hundreds of thousands of units which furnish power for all kinds of useful work. Service throughout the nation is provided by hundreds of Authorized A. O. Smith Motor Service Stations. Write today for information on standard or special types.

A.O.Smith

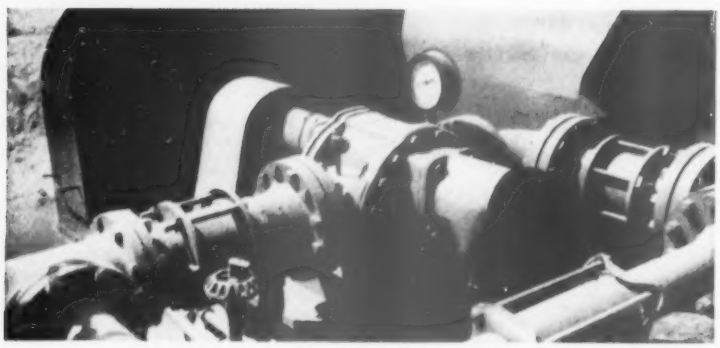
ELECTRIC MOTOR DIVISION

FACTORIES: 5715 SMITHWAY ST., LOS ANGELES 22, CALIF. • 1000 WEBSTER ST., DAYTON 4, OHIO

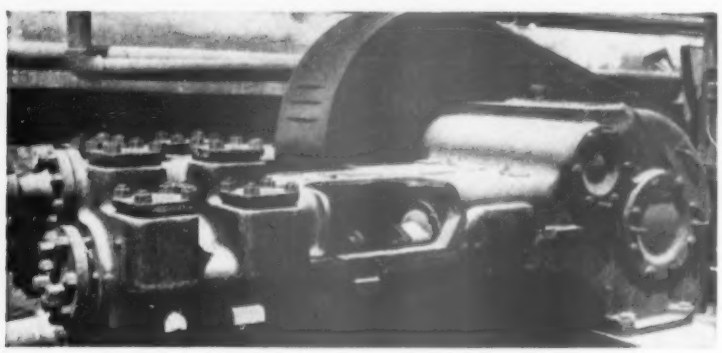
Offices in Principal Cities. International Division, Milwaukee 1

Why 3 different pumps for 3 similar Jobs?

WORTHINGTON STEAM PUMP at a West Coast petroleum company delivers 10° API crude oil from a lease tank to several treating tanks. Available steam drives this heavy-duty pump with minimum power costs. A single boiler is used for heating the oil before it is pumped, as well as supplying steam to drive the pump.



WORTHINGTON ROTARY PUMP handles approximately 300 GPM of 32° API crude oil at the Tidewater Associated Oil Company in Ventura, California. At pressures ranging from 250 to 325 psi, the crude oil is pumped from a dehydration plant to a central group of tanks. Throughout the country, Worthington rotary pumps have proven themselves in refinery service, handling anything from asphalt to gasoline.



WORTHINGTON POWER PUMPS at the Continental Consolidated Corp., in Long Beach, California, move 14-16° API crude oil from a lease tank through a pipeline to nearby refineries. The pumps have been in service for eight years, handling crude oil against pressures ranging from 200 to 600 psi. This heavy-duty pump is ideal for all large capacity, high-pressure service.

Three different types of Worthington pumps were installed for the same kind of service at these oil companies. Why? Because the combination of pressure requirements and the type of power available differed in each case. Worthington, the oldest and largest pump manufacturer in the world, can give you *exactly* the pump for your needs. Get in touch with your nearest Worthington district office for more details. Or write directly to Worthington Corporation, Reciprocating Pump Division, Harrison, New Jersey.

P-3-1

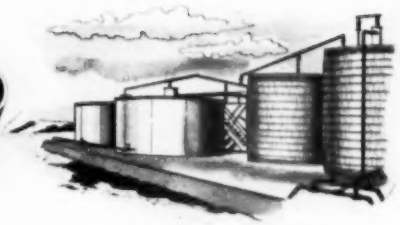
The World's Broadest Line Assures You the Right Pump for Every Job

WORTHINGTON

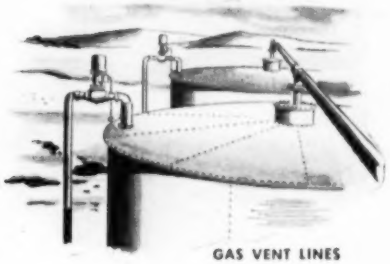
Reciprocating and Rotary Pumps

*Only Carlon**

FOR OIL COUNTRY PIPING

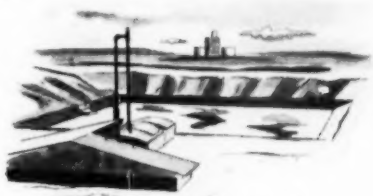


LEAD AND GATHERING LINES



GAS VENT LINES

FRESH WATER LINES



SALT WATER LINES AND TUBING

LEAD LINES AND RISERS

Specify **Carlon** plastic pipe for oil piping that completely resists corrosion. **Carlon** is immune to the corrosive effects of salt water, crude oil, sour crude, and corrosive earth as well as rot, rust and electrolytic action. **Carlon** lasts longer on every job . . . practically eliminates replacement and maintenance.

Carlon can be installed faster. No special tools or cumbersome rigging equipment is required.

Permanent leakproof connections can be made to plastic or existing metallic systems.

Only 1/8th the weight of steel pipe, **Carlon** can be transported easily. Several lightweight sections can be carried by one man . . . less time is needed for installation work.

Install oil piping that's corrosionproof . . . install piping faster . . . easier . . . Specify **CARLON** plastic pipe for all oil country piping.

* The First REAL PIPE that is Plastic • BUY THE PIPE WITH THE STRIPE!

1544-CP

Send today for literature.

CARLON
CP
THE PIPE WITH THE STRIPE

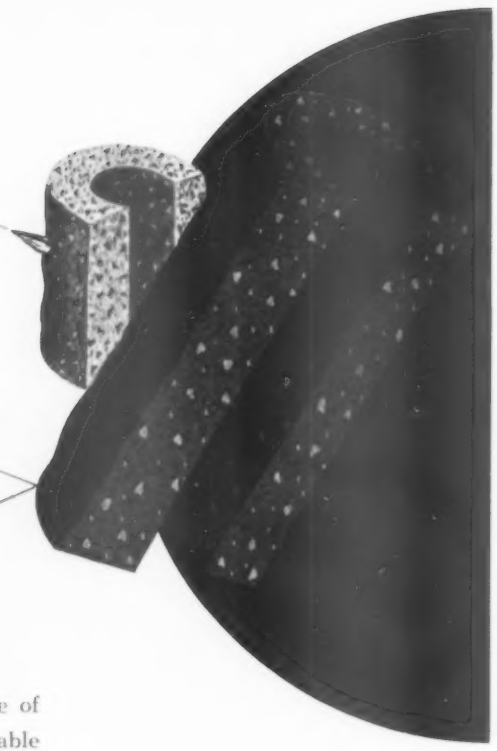
CARLON PRODUCTS CORPORATION

Pioneers in Plastic Pipe

10201 MEECH AVE. • CLEVELAND 5, OHIO

CARLON plastic pipe is produced in Texas, Colorado, Ohio, Oregon, North Carolina and Acton, Ontario, Canada.

increased water tightness
limits corrosive action !



HALLIBURTON'S POZMIX CEMENT

Greater resistance to sulfate waters is one of the top advantages in using this remarkable slurry in the cementing of oil wells.

Pozmix is an exclusive Halliburton blend of pozzolanic materials and Portland cement. This combination is more effective than ordinary cements in limiting corrosive action because the pozzolans unite with calcium hydroxide formed by hydration of Portland cement to provide extra water tightness.

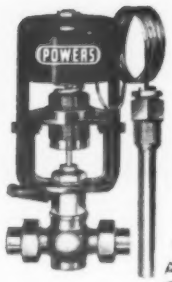
Nullifying the effects of acid water is a prime benefit of this outstanding slurry. But Pozmix also provides several other important advantages: (1) lower density and lighter weight that minimize breakdown of soft formations... (2) better protection for well casing... (3) superior tensile and compressive strength... (4) lower heat of hydration... (5) greater resiliency.

And yet, Pozmix actually costs less.

Over a million sacks have been used in a matter of months for longer-lasting, stronger cementing jobs. For more secure cementing, phone your nearby Halliburton representative for Pozmix. Or contact Halliburton Oil Well Cementing Company, Duncan, Oklahoma.

HALLIBURTON

YEARS AHEAD IN OIL WELL CEMENTING!

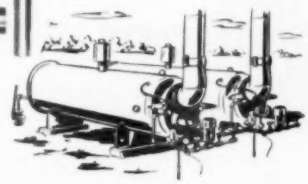


POWERS No. 11-OFT REGULATOR

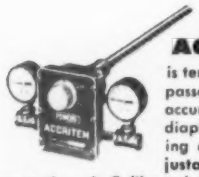
for Heaters and Treaters

Self-Operating • Dependable Economical

Has many features that give better control and long, trouble-free service without repairs . . . in all kinds of weather.



Applied to BS&B Indirect Heaters

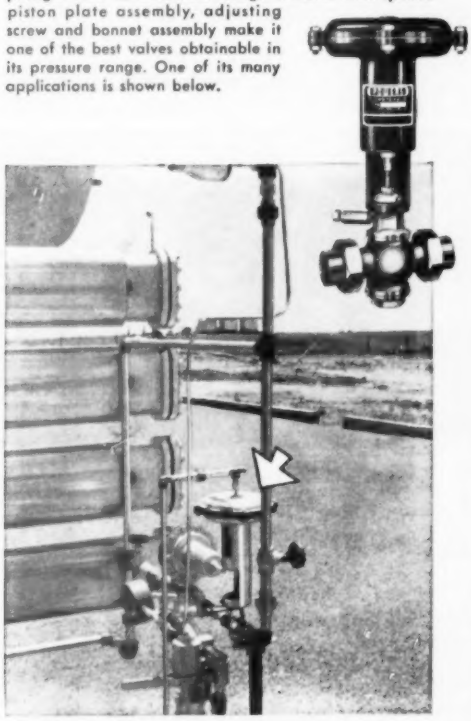


ACCRITEM REGULATOR

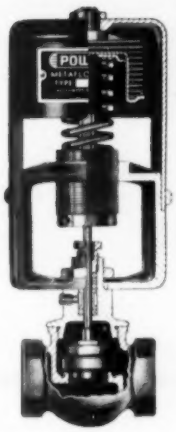
is temperature actuated and unsurpassed for reliability and power to accurately control large or small diaphragm valves regulating heating or cooling mediums. **Has Adjustable Sensitivity** and over-heat protection. • Calibrated Dial temperature adjustment. • Ranges 50 to 250° F. and 150 to 350° F. • **Simple, Rugged Construction** withstands vibration and insures many years of reliable service. Requires 15 lb. supply of compressed air or gas for its operation. Write for Bulletin 316.

POWERS FLOWRITE DIAPHRAGM VALVE

is a high quality diaphragm control valve for line pressures below 250 psi. Its durable molded Neoprene diaphragm with its advanced design features and special piston plate assembly, adjusting screw and bonnet assembly make it one of the best valves obtainable in its pressure range. One of its many applications is shown below.



POWERS FLOWRITE VALVE controlling gas heater to Dehydrator unit in gas booster station at El Paso Natural Gas Co., Snyder, Texas.



POWERS METAFLOW DIAPHRAGM VALVE

Mr. George Freeman of Black, Sivalls & Bryson, adjusting a

POWERS

METAFLOW VALVE

Used as a Pressure-Stat on the above Horizontal Treater—

There are many profitable uses for this small, sturdy, lightweight, reasonably priced diaphragm control valve. It's suitable for applications where pressures are below 75 psi.

Specifications: Has a long life hydraulically formed metal bellows, a brass adjusting screw, and rust-proofed steel spring with 15 lbs. adjustment range. Polished stainless steel stem in preformed lubricated packing insures long life and low hysteresis. **Valves**—sizes ½ thru 2" have bronze bodies with screwed ends and rugged construction to withstand piping strains. Valve stem lubricator, optional. **Trim**—Composition disc with integral seat and self-aligning disc holder, available normally open (direct acting) or normally closed (reverse acting).

Write for Bulletin 346

(b2

THE POWERS REGULATOR COMPANY

SKOKIE, ILLINOIS • Offices in Over 50 Cities in U. S. A., CANADA and MEXICO

See Your Telephone Directory

OVER 60 YEARS OF AUTOMATIC TEMPERATURE CONTROL

Announcing new Parker *"In-tru"* Fittings for easier, foolproof installations

Simply push—then tighten! That's all you have to do to install the new Parker *"In-tru"* tube fittings. These flareless fittings are especially well suited for instrumentation lines of ¼" through ½" outside diameters. Here's what makes them so easy and foolproof to use . . . even by pickup labor on construction jobs:

To connect a Parker *"In-tru"* fitting, you don't have to take the fitting apart. Just do three things. First, cut off the tube squarely. Second, push the tube through the nut and ferrule until it rests on the seat within the fitting body. Then, tighten the nut.

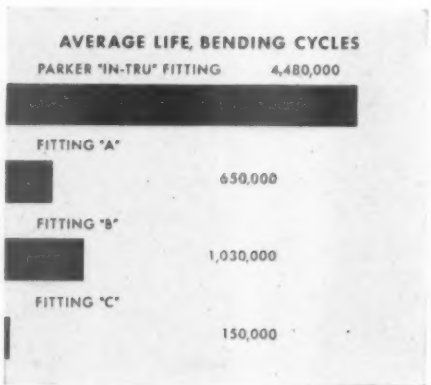
The wedging action of the nut, when tightened, causes the ferrule to "bite" into the outer surface of the tube wall. This turns up a shoulder of metal for a leakproof, vibration-proof connection. The cutting action of the ferrule is not hidden, so the extent of the "bite" is plainly visible if the joint is disconnected to examine the "bite".

Leakproof Parker *"In-tru"* fittings are made of brass. They are also available in aluminum alloy on special order.

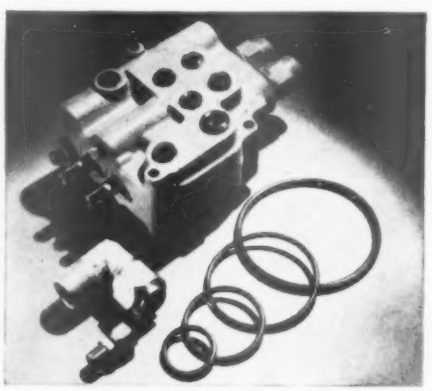
Call your nearest Parker distributor for complete information about shapes, sizes, and prices. Or, write us for Catalog 4320A1.

TUBE AND HOSE FITTINGS DIVISION
The Parker Appliance Company
Section 402R, 17325 Euclid Avenue, Cleveland 12, Ohio

Parker
Hydraulic and fluid system components



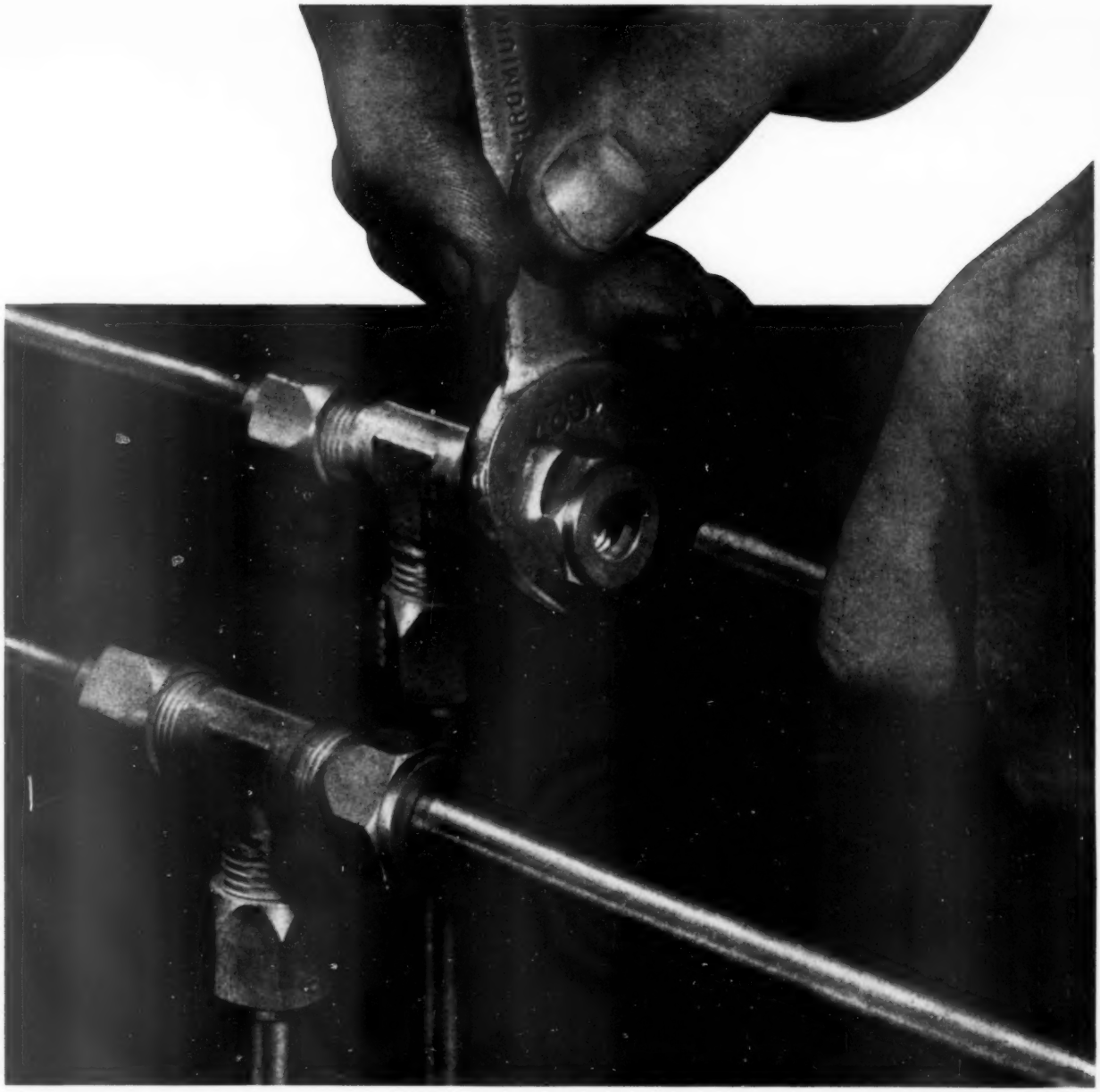
Vibration life tests proved Parker *"In-tru"* fittings averaged four-times longer life than any of the three competitive makes tested.



What other Parker products interest you? Triple-lok flare fittings? Hydraulic control valves? O-rings? Write us for information.

CALL YOUR NEAREST DISTRIBUTOR FOR PARKER INDUSTRIAL FITTINGS

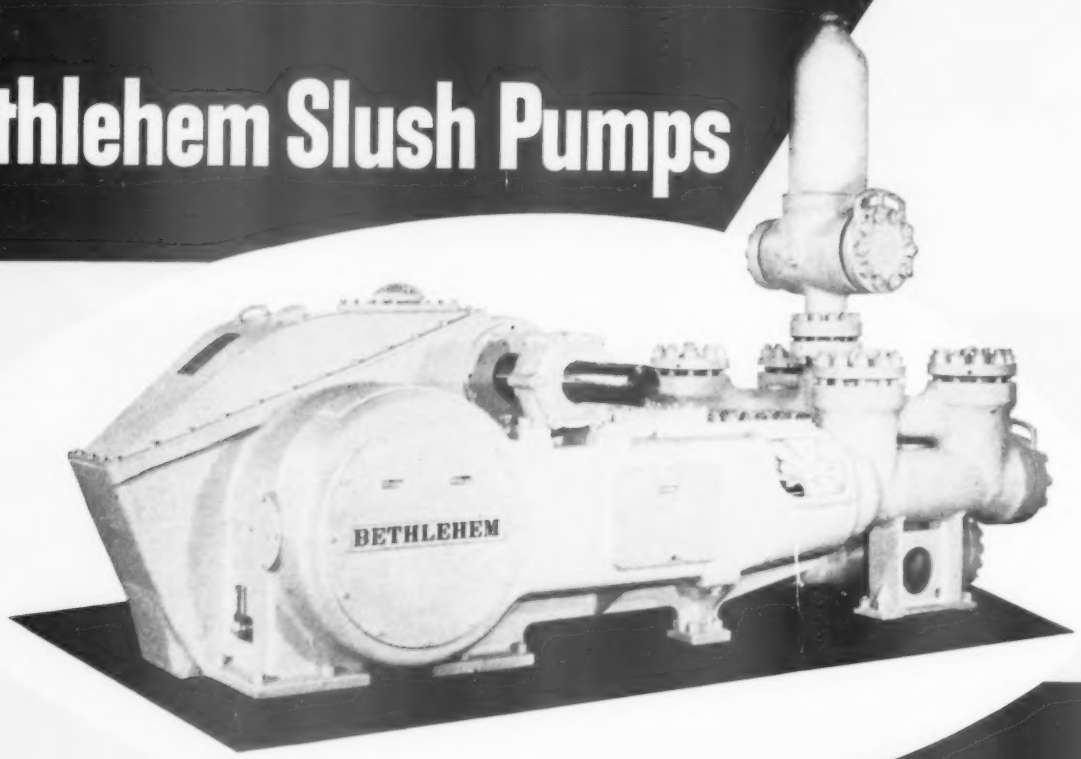
Akron 9, Ohio	B. W. Rogers Co. 850 South High St.
Baltimore 13, Md.	Carey Machinery & Supply Co. 3501 Brehms Lane
Baltimore 6, Md.	Whitehead Metal Products Co. 4300 E. Monument St.
Beaumont, Tex.	Standard Brass & Mfg. Co. 705 Milam St.
Birmingham, Ala.	Mill & Textile Supply, Inc. 3128 Third Ave. South
Boston 15, Mass.	A. E. Borden Co., Inc. 176 Brookline Ave.
Bryson City, N. C.	Wallace Co. of N. C. P. O. Box 572
Buffalo 7, N. Y.	Whitehead Metal Products Co. 2128 Elmwood Ave.
Cambridge 39, Mass.	Whitehead Metal Products Co. 281 Albany St.
Cedar Rapids, Ia.	Globe Machinery & Supply Co. 309 8th Ave. S. E.
Charleston, W. Va.	Persingers, Inc. 514 Elizabeth St.
Charlotte 1, N. C.	Industrial Piping Supply Co. 1501 Dowd Rd.
Chicago 14, Ill.	Wallace Tube Co. 1300 Diversey Parkway
Cincinnati 29, Ohio	Williams & Co. 3231 Fredonia Ave.
Cleveland 14, Ohio	B. W. Rogers Co. 1279 East 12th
Cleveland 14, Ohio	Williams & Co. 3700 Perkins Ave.
Columbus 8, Ohio	Williams & Co. 851 Williams Ave.
Dallas 9, Tex.	Metal Goods Corp. 6211 Cedar Springs Rd.
Davenport, Ia.	Globe Machinery & Supply Co. 410 E. Second St.
Dayton 10, Ohio	J. N. Fauver Co. 1534 Keystone Ave.
Denver 2, Colo.	Metal Goods Corp. 2425 Walnut St.
Des Moines 6, Ia.	Globe Machinery & Supply Co. East First & Court Ave.
Detroit 1, Mich.	J. N. Fauver Co. 49 West Hancock St.
Harrison, N. J.	Whitehead Metal Products Co. 1000 South Fourth Ave.
Houston 3, Tex.	Metal Goods Corp. 711 Milby St.
Houston 1, Tex.	Standard Brass & Mfg. Co. 2018 Franklin St.



Simply push, then tighten. Anyone can quickly install new Parker *"In-tru"* tube fittings. You don't even have to take them apart before making connections. These flareless fittings are both leakproof and vibration-proof. They are designed for instrumentation lines using ¼" through ½" outside diameters.

Indianapolis, Ind.	Avels Sales & Engineering Co. 16 W. 22nd St.
Jacksonville, Fla.	Florida Metals, Inc. 2937 Strickland St.
Kansas City 16, Mo.	Metal Goods Corp. 1300 Burlington Ave.
Knoxville 5, Tenn.	Leinart Engineering Co. 412 E. 5th Ave.
Los Angeles, Cal.	Haskel Engineering & Supply 721 Broadway, Glendale 4
Los Angeles 12, Cal.	Metropolitan Supply Co. 353 E. 2nd St.
Memphis, Tenn.	J. E. Dilworth Co. 730 South Third St.
Miami, Fla.	Florida Metals, Inc. 4100 N. W. 37th Ct. Hialeah
Milwaukee 3, Wis.	Morman Belting & Supply Co. 522 W. State St.
Milwaukee 4, Wis.	Wallace Companies of Wisconsin, Inc. 838 South 6th St.
Minneapolis 15, Minn.	Vincent Brass & Copper Co. 124 Twelfth Ave. South
New Orleans 12, La.	Metal Goods Corp. 432 Julia St.
Newport News, Va.	Noland Company 27th St. & Virginia Ave.
New York, N. Y.	Nielsen Hydraulic Equipment, Inc. 5 Penn Place, Pelham Manor 65
New York 14, N. Y.	Whitehead Metal Products Co. 303 W. 10th St.
Odessa, Tex.	Snyder Co., Inc. 2604 Kermit Highway
Philadelphia, Pa.	Louis H. Hein Co. 15 W. Lancaster Ave., Ardmore
Philadelphia 40, Pa.	Whitehead Metal Products Co. 1955 Hunting Park Ave.
Pittsburgh 33, Pa.	Williams & Co. 901 Pennsylvania Ave.
Portland 10, Ore.	Hydraulic Power Equipment Co. 2316 N. W. Savier St.
Roanoke 10, Va.	Noland Company 1226 Center Ave. N. W.
Rockford, Ill.	Rockford Tool & Transmission Co. 802 Broadway
Salt Lake City 4, Utah	Pace-Turpin & Co. 726 South Third West
San Francisco 3, Cal.	General Machinery & Supply Co. 1346 Folsom St.
Seattle 9, Wash.	Palmer Supply Co. 222 Westlake North
Shreveport, La.	Standard Brass & Mfg. Co. 1557 Texas Ave.
St. Louis 15, Mo.	Metal Goods Corp. 5239 Brown Ave.
Syracuse 4, N. Y.	Whitehead Metal Products Co. 207 W. Taylor St.
Tampa, Fla.	Florida Metals, Inc. 222 N. 12th St.
Toledo 2, Ohio	Williams & Co. 650 E. Woodruff Ave.
Tulsa, Okla.	Ardun Supply Co. 303 S. Frankfort
Tulsa 3, Okla.	Metal Goods Corp. 302 N. Boston
Export	Mercator Corp. 438 Walnut St., Reading, Pa., U.S.A.

Bethlehem Slush Pumps



are built to handle volume

For depths ranging from 3500 ft to maximum, Bethlehem offers heavy-duty slush pumps in four different sizes. All are unusually powerful units, all have the "push" needed for fast, continuous circulation.

But that's only part of the story. The pumps have something else that's just as essential in present-day drilling. They are built to handle *volume*. Each of the four sizes, even the smallest, has a bore that accommodates an 8-in. liner. Since strokes are 14, 16, and 18 in., it's obvious that these pumps can move a lot of fluid.

And even a quick look will show you the sturdiness of the fluid end. It's heavy and massive, with plenty of strength in reserve, far more than the pressures call for.

Other features, all of them marks of a well-planned, well-built slush pump, include oil-bath lubrication . . . roller bearings throughout . . . A.P.I. metal ring gaskets on valve covers, suction flanges, discharge flanges, and stuffing boxes.

Ask for full details of these powerful, durable, two-fisted pumps. They will do a real job for you—now and in the years to come.

BETHLEHEM
Heavy-Duty
SLUSH PUMPS

Size (Input Hp)	Bore & Stroke
225	8 in. x 14 in.
325	8 in. x 16 in.
450	8 in. x 16 in.
600	8 in. x 18 in.

BETHLEHEM SUPPLY COMPANY

General Offices: 21 E. Second St., Tulsa, Okla.
West Coast Headquarters: Los Angeles, Calif.
Export Distributor: Bethlehem Steel Export Corporation
25 Broadway, New York, N. Y.

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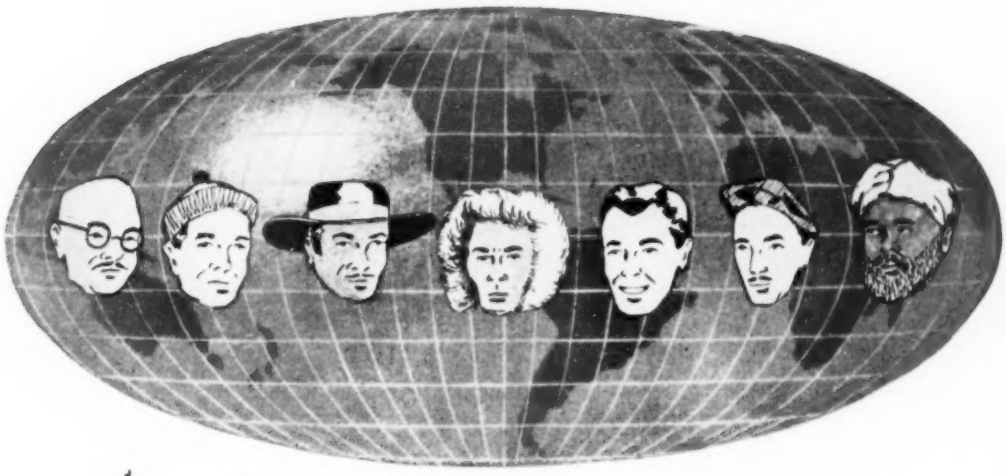

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A gas engine to be considered successful must have "acceptance". Every component, too, must likewise be acceptable—acceptable from the standpoint of performance and ease of service and repair. An acceptance upon which repeat business is built comes from a satisfaction and familiarity with the product through years of daily use. Our original service policy which calls for interchangeability and availability of replacement parts for carburetors 20 to 25 years old has helped immeasurability in building ENSIGN acceptance. Operators everywhere are more familiar with an engine when it is equipped with ENSIGN!

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Model "B" Fuel Regulator
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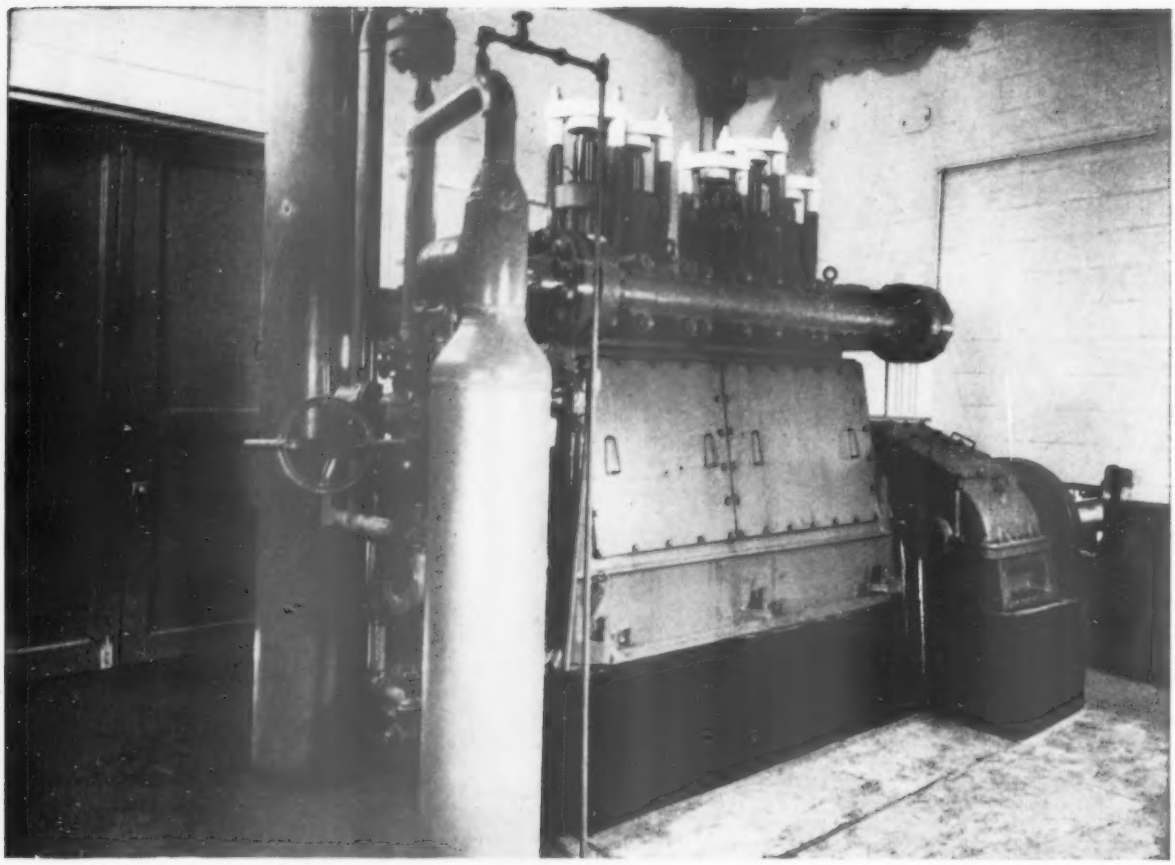

ALDRICH PUMPS Send Liquids Through Cross-Country Pipe Line

In service at the North Salt Lake Pumping Station of the Salt Lake Pipe Line Company, this Aldrich Quintuplex Inverted Direct Flow Pump and a twin unit are used to pump liquid products through an 8″ pipe line to Boise, Idaho, some 350 miles distant.

Fluids sent on their long distance journey by these Aldrich Pumps include regular and premium automotive gasolines, Diesel fuels, stove oils and alkyate. Pumps feed 375 gpm, against maximum discharge pressure of 1700 psi. Suction pressure averages 30 to 40 psi. Installed in December 1952, these pumps already have been in operation more than 2000 hours each.

This operating performance story is typical of Aldrich's record throughout the oil industry. In whatever way they're called upon to serve—whether water flooding, lean oil service, salt water disposal, crude and gathering lines, product lines, bottom hole pump service, or pumping liquid hydrocarbons—Aldrich Pumps set standards for dependable operation.

With Aldrich Pumps the user gets several marked construction advantages and benefits. For example, fluid ends are sectionalized, so that parts can be replaced quickly and at low cost. Plunger sizes are changeable, and wearing parts are interchangeable among pumps of the same stroke sizes. And ample stocks of spare parts are maintained at Mid-Continent and California locations.

Aldrich Direct Flow units are available in 3″, 5″ and 6″ stroke sizes, with 3, 5, 7, or 9 plungers . . . range from 10 to 2400 hp. Pressures are available to meet requirements (up to 15,000 psi or higher).

Write for catalogs, engineering service or a representative's call. We invite your inquiries.

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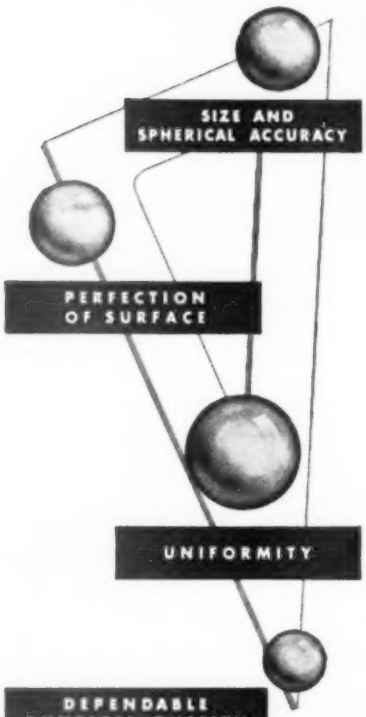

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THE **TWIN 6-110**

GENERAL MOTORS DIESEL

- ★ Substantially lower cost
- ★ More power from less space and weight
- ★ Torque-converter equipped

HERE'S General Motors' newest oil field Diesel engine—the power-packed 2-cycle Twin 6-110.

It is 50% more powerful than the famous GM Twin 6-71 that powers more drilling rigs than any other Diesel—yet it has outstanding compactness and light weight. It fits existing compounding case centers.

The new Twin 6-110 gives drillers a wide range of power from a single unit. New dumping type torque converters allow one-engine operation for light load requirements, but the "Twin" power is there when needed.

With Torque Converters, the Twin 6-110 costs 11% less than competitive engine A and 16% less than engine B *without* torque converters in the table below.

	TWIN 6-110	ENGINE A	ENGINE B
Rated H.P.	505	472	460
Continuous H.P.	394	372	375
Width (approx.)	66*	58	66
Length (approx.)	122*	163	92
Height (approx.)	83*	85	108
Weight (approx.)	12,200*	14,080	21,000

*With Torque Converters. All other figures without Torque Converters.

Get the complete story on General Motors' new Twin 6-110 Diesel from your distributor or supply company, or write us.

DETROIT DIESEL
ENGINE DIVISION
GENERAL MOTORS • DETROIT 28, MICH.
It pays to standardize on

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GENERAL MOTORS
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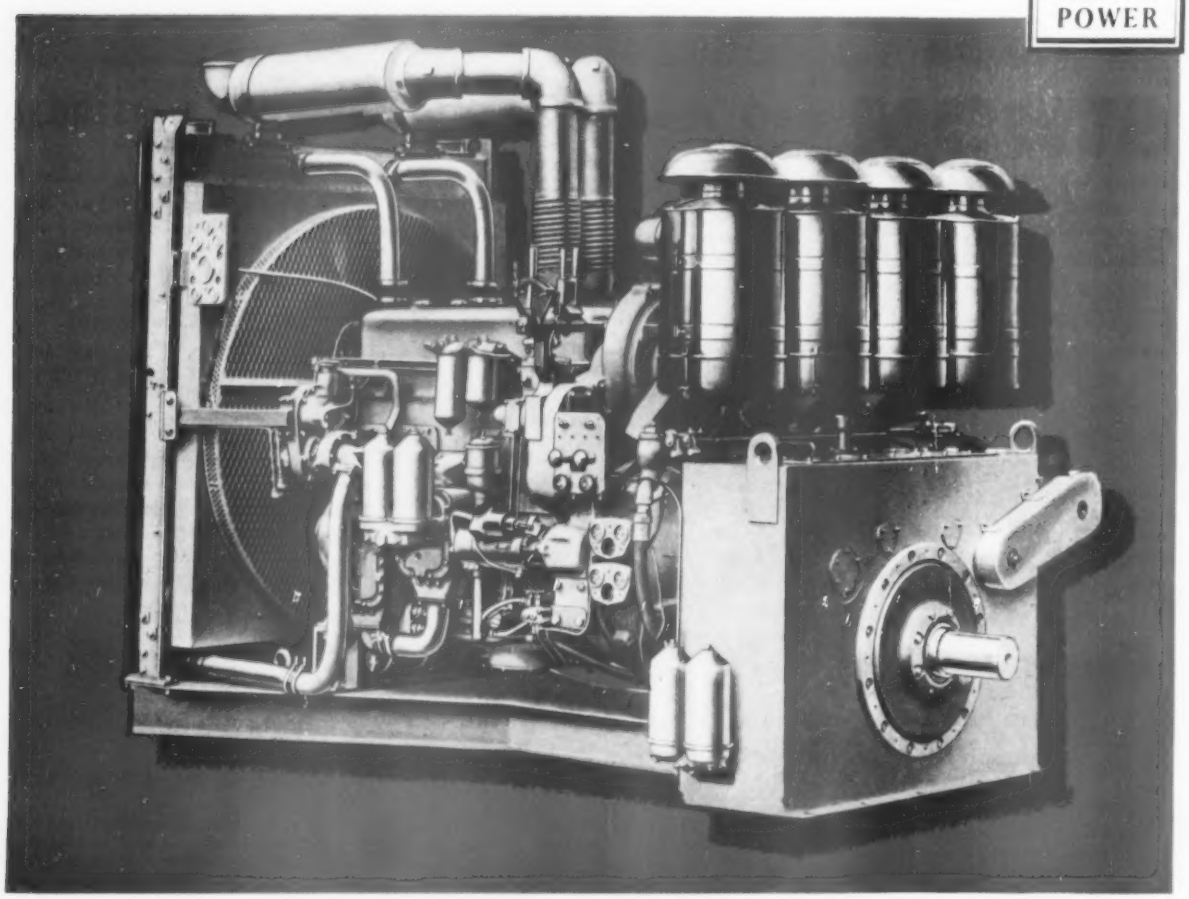
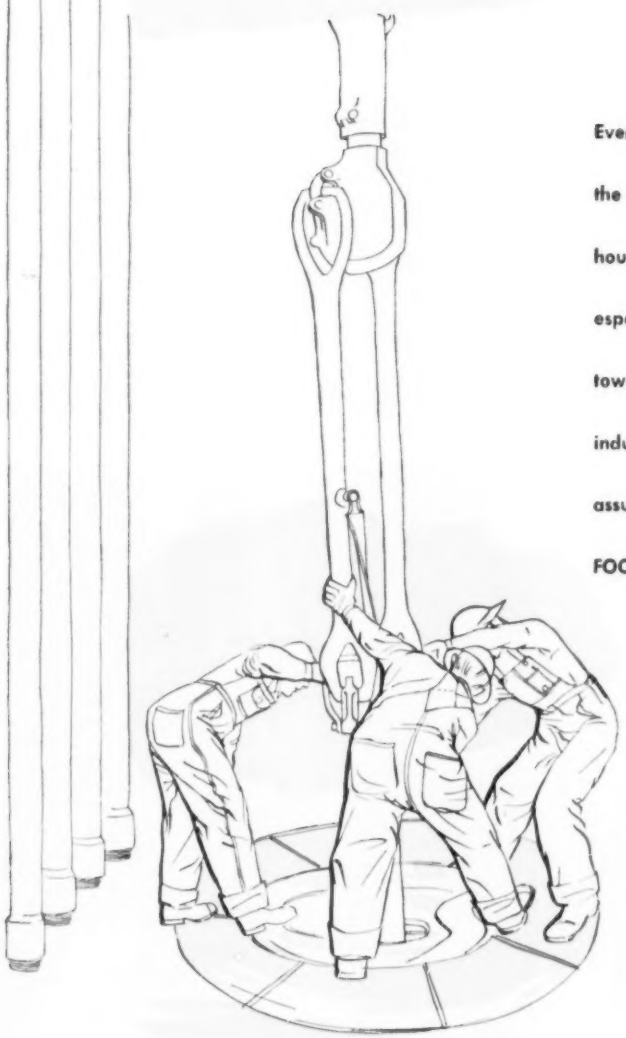


How much does a round trip cost?



Every company knows that round trips are costly, because of the non-productive hours it takes to complete a round trip . . . hours which could be used making additional hole. Today, especially since the trend in the never-ending search for oil is toward deeper and still deeper wells, men in the petroleum industry can appreciate Christensen Diamond Drilling Bits for assurance of drilling with fewer round trips at "LESS COST PER FOOT."

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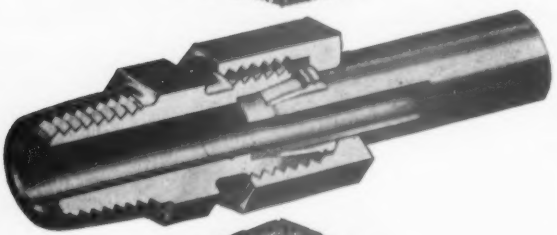
DIAMOND PRODUCTS COMPANY

1937 SOUTH SECOND WEST SALT LAKE CITY, UTAH

Get a Positive Leakproof Seal in 30 Seconds with WEATHERHEAD ERMETO® Tube Connectors



NO FLARING!
No Threading! No Welding! No Soldering!

FASTER, because a wrench is the only tool you need for installation.

POSITIVE, because you get a vibration-resistant line-to-line seal *between the sleeve and the body of the fitting* and *between the tube and the cutting edge of the sleeve.*

ECONOMICAL, because the seal is good for the life of the tube. You can disconnect and reconnect the joint and still have a pressure-tight connection.

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- See it work — you know it's working all the time
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- Simply screw into oil pressure line or on block. Run wire to magneto ground terminal.

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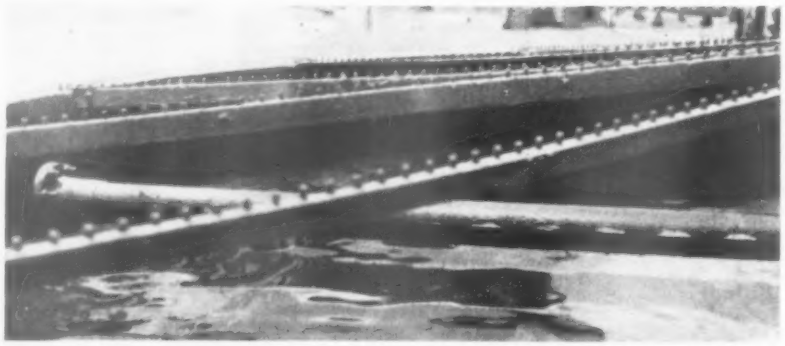
Skimming tank for oil condensate

A 1,000-bbl. tank equipped with an overhead perforated 6-in. line is used for removing heavy accumulations of oil from oily condensate at Trinity Gas Corp.'s cycling plant in Sejite field, South Texas.

Oil condensate from all condensers at the plant is pumped into a common header and enters the skimming tank.



This 1,000 bbl. tank with overhead perforated 6-in. line is used by Trinity Gas Corp. as a skimming tank for oily condensate at its cycling plant in South Texas.

The tank is low and its wide diameter gives it a broad enough surface so that the majority of the sludge will accumulate on the liquid surface in the tank.

As the oil sludge becomes thick in the tank, water is pumped in so as to raise the liquid level, whereupon the sludge, plus a small amount of water is skimmed off through the perforated 6-in. line. This line runs diametrically across the tank, near its top, and has fairly large-size holes cut along its sides. The line is tilted slightly to allow gravity runoff of the skimmed sludge.

Once the accumulation of sludge has been removed from the skimming tank, its level is lowered so as to receive more condensate. Meanwhile, the oil-water skim is taken to a settling basin from which the oil is then pumped to a slop tank and rerun at a convenient time.

Plant superintendent for Trinity is J. O. Jones.

Gas-water drive aids in analysis

A GAS-WATER drive can be used for forcing specimens out of sample bombs into Pod columns for analysis.

At LaGloria Corp.'s Falfurrias, Tex., plant, a tank made from line pipe is used to hold water which is then forced out of the tank by injecting high-pressure gas into the sample bomb.

Water enters through the top of the tank, while air and gas within the tank are bled off through a valve located near the top of the tank. The water can reach the bomb through flexible tubing which extends from the tank, located outdoors, to the laboratory equipment.

High-pressure gas enters through the

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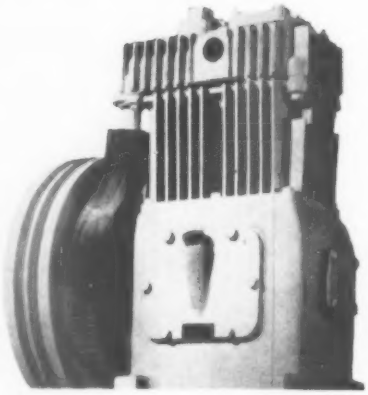

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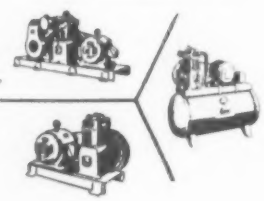

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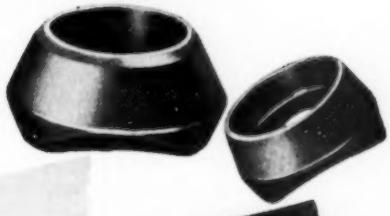

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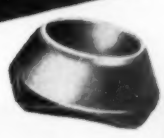

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Send for details on JET-LUBE Applicator and "The Inside Story of JET-LUBE Thread and Valve Lubricants."

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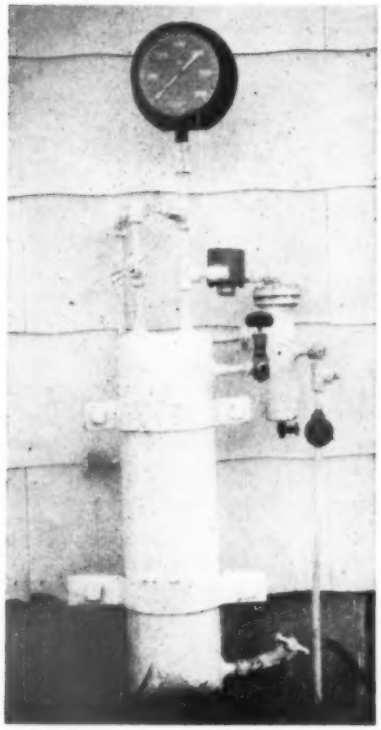


La Gloria Corp., at Falfurrias, Tex., uses this tank in moving samples into Podbielniak columns for gas analysis.

top of the tank after first passing through a water trap and high-pressure regulator. A gage is mounted on this line for checking purposes.

How Dow plant disposes of wastes

ON land, sea, and air, a continuous battle is being waged against pollution at Dow Chemical Co.'s Texas Division plants near Freeport.

The strategy revolves around two groups of waste-control teams—one to keep up on the day-to-day waste-disposal conditions and one to make long-range research studies with the aim of improving waste-control practices.

These teams, operating with the blessing of Dr. A. P. Beutel, Dow's Texas Division general manager, work to combat and eliminate contaminating waste wherever it occurs—at its source (processes) and in its discharge from the plants.

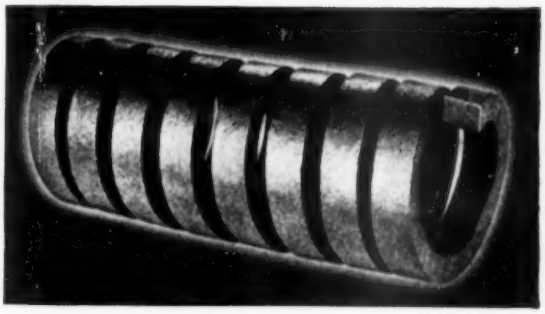
The procedures followed are, as would be expected, as varied as the products handled and range from the simple to the highly complex, involving much fundamental research.

On land . . . Solid wastes are both the easiest to control and the simplest to dispose of, especially in the flatlands of the Texas Gulf Coast, where these materials are used by Dow to build up low areas, reinforce levees, and make roadbeds. Several tar wastes receive the burying or impounding treatment which effectively disposes of these substances and eliminates bothersome smoke or odors which could result if they were handled otherwise.

In the air . . . The problem of waste gases becomes far more complex for the mixing of two harmless components can result in annoying odors once they are flared together. Indiscriminate mixing of waste gases is therefore avoided with a closely controlled procedure being followed in the flaring of gases.

Suitable equipment is also sought after in the over-all waste-control problem, with each individual operation requiring separate attention. One particular situation involved smoke from a set of evaporator stacks. On this unit,

Wherever you turn in a refinery you'll find a use for R/M VERSI-PAK®



When you have R/M versi-pak on hand you don't have to stock a large number of special packings. This all-round packing made by Raybestos-Manhattan works well on centrifugal, rotary and reciprocating equipment. It resists temperatures up to 350°F. and pressures up to 600 psi. It resists crude oil, gasoline, naphtha, steam, gas, and a long list of chemicals. Because versi-pak is easily compressed, you can "take up" on glands to compensate for wear. Streamline and simplify your packing inventory with versi-pak. Write us for samples and data, or call in your R/M distributor.

R/M K-684 . . . Neoprene and asbestos sheet

R/M Teflon* Valve Stem Packing . . . For use against chemicals

R/M V-Square® . . . For oil-field mud pumps

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*Du Pont trade-mark for its tetrafluoroethylene resin

R/M PACKINGS

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FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Passaic, N.J.; Neenah, Wis.; Crawfordsville, Ind.; Peterborough, Ontario, Canada

RAYBESTOS-MANHATTAN, INC., Manufacturers of Packings • Teflon Products • Asbestos Textiles • Industrial Rubber Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts • Radiator Hose • Sintered Metal Products • Bowling Balls

KOBE *for Better Pumping*

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Free Pump

KOBE

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1A

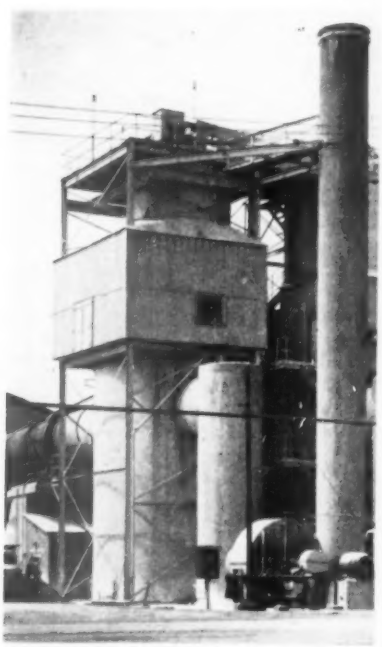
Dow finds that solid waste materials contribute no specal disposal problem since they can be used as fill in building up levees and other earthworks in the flat coastal area surrounding the plant.

a water-wash chamber was installed which wet down the dust in the waste vapor stream to prevent its being carried out to form smoke. At another plant, a similar situation required the use of electrostatic precipitators.

In the water . . . Water receives an equally critical check as samples are constantly being taken from streams in the immediate and nearby vicinity of the plants and analyzed to determine its constituents. Should any disturbance in river conditions occur, the team responsible backchecks until the particular source of the disturbance is located. From there they work with operating personnel so as to correct the situation.

While the day-by-day checks go on, the research teams are at work to curb waste at its source. While their efforts may be realized in new equipment and changes in test procedure, they have also been felt to the extent that widespread process changes have been put into effect to curb an undesirable condition.

The favorable results recorded from this over-all program have been tied in directly with top management's desire to maintain its nation-wide reputation in the field of industrial waste disposal. With the problem being accepted as a regular part of operations and with waste-disposal teams reporting to the division's operating board, management is kept closely informed on the program in its entirety.



In addition to electrostatic precipitators in use on some units, Dow also employs a water-wash system at this lime kiln to cut down on smoke by washing dust particles from stack gases.

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ENAMELS
Armed by Reilly's Intermediate Grade Enamel metal surfaces are protected from corrosion where excessive stresses and temperatures are not forecasted.
Armed with a vast knowledge of the secrets of coal tar properties, accumulated through more than fifty years of practical operations and research, Reilly has for other conditions other grades of Hot Application Coal Tar Base Enamels. . . . 230 A Plasticized, 230 (AWWA), Pipeline.
Write to us for the 24-page booklet on Reilly Protective Coatings. We shall be glad to help you with your particular needs.
Photo: Lake Shore Pipe Line courtesy of the Lake Shore Gas Company of Ashtabula, Ohio.
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PROTECTIVE COATINGS
REILLY TAR & CHEMICAL CORPORATION
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Field lines heated to insure flow

FIELD lines for handling the heavy crude produced in the Red Wash, Utah, field by The California Co. are electrically heated to insure proper flow. The viscous oil will not flow freely at temperatures below 90° F., due to high paraffin content.

For installation of heating cable sets on The California Co.'s lines at Red Wash, Utah, five sets of the heating cables were placed on a special rig and threaded through a circular guide.

The oil is produced from a depth of approximately 5,000 ft. and pumped to storage in field tanks. Surplus gas from the field is used to maintain oil temperature in the tanks at approximately 100° F.

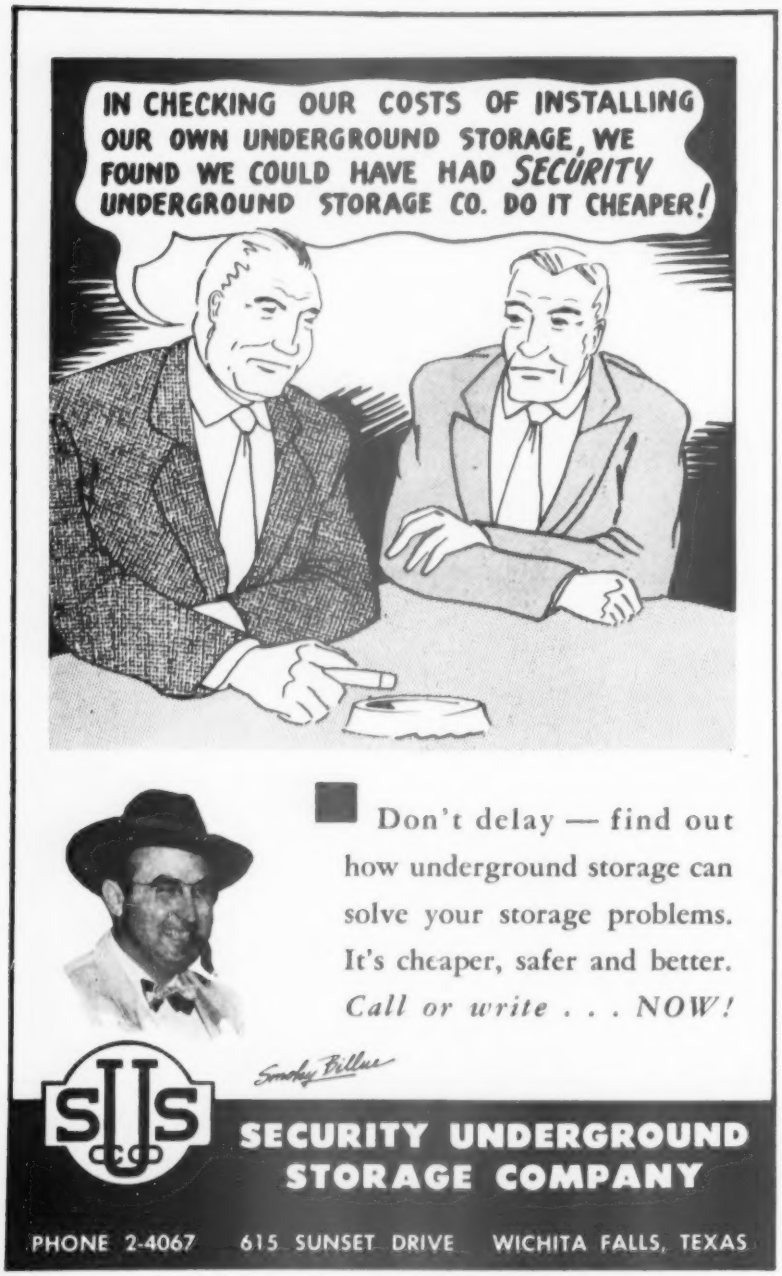
From lease tanks the oil is pumped through approximately 7 miles of field pipe line for injection into a trunk pipe line. Here it is mixed with other crudes for shipment to refineries.

Heating cables . . . Lead-covered heating-cable sets are attached to the field lines to maintain the oil at the proper temperature in transit. Each heating-cable set is 437 ft. in length, with 20-ft. G. E. Geoprene nonheating leads permanently molded to the cable. The sets were first precoated with an asphalt-base primer. Five of these sets at a time were then mounted on a special payoff rig and threaded through a circular guide so that five parallel cables could be applied simultaneously to the line.

As the cable was run along the pipe, operators applied a ⅛-in. coating of asphalt enamel, followed by a glass-cloth wrap to hold them in place. A second application of asphalt was then put over the glass wrap. At each control point the bulb of the thermostatic control was laid in direct contact with the line, under the glass-cloth wrap. The thermostat bulb was then wrapped with an aluminum-foil insulating material and covered with a watertight compound.

Power-line poles were installed every 435 ft. for the power connections to the heating cables. Automatic thermostat controls were located at alternate poles.

Selection of the electric heating method was based on an economic study of the pumping problem. Excessive pumping costs result when pumping the cold, viscous oil.


IN CHECKING OUR COSTS OF INSTALLING OUR OWN UNDERGROUND STORAGE, WE FOUND WE COULD HAVE HAD SECURITY UNDERGROUND STORAGE CO. DO IT CHEAPER!
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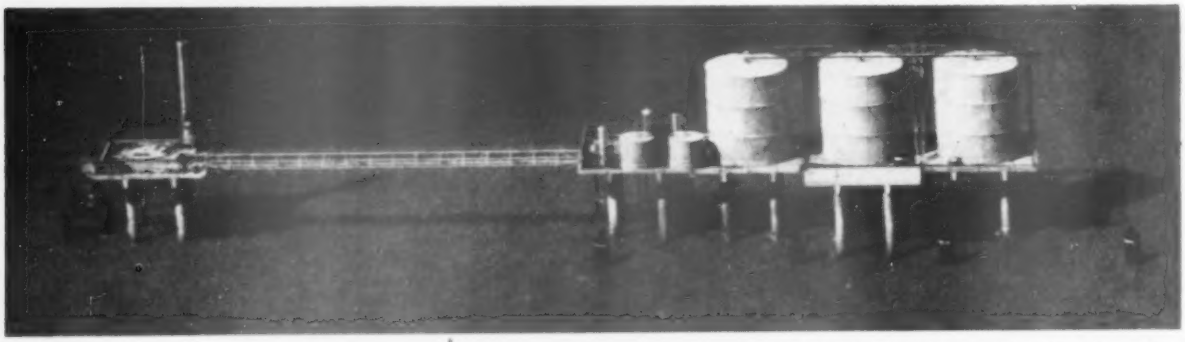

The California Co. tank battery in offshore Louisiana, located on prestressed concrete piles.

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The collective scientific knowlege and experience of our staff, 21 years of operation—plus, the finest, most accurate scientific apparatus is dedicated to one ideal—*Service to the Oil Industry.* We invite your inquiry, whether your problem is a one-time project or long-range continuing tests.

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KNOW BY TEST

"A hair perhaps divides the false and true"—Omar

TULSA TESTING LABORATORY

TULSA • WICHITA

Tanks supported on prestressed concrete

THE California Co. has installed tank batteries on prestressed concrete piles in the Main Pass Block 35 area, offshore Louisiana.

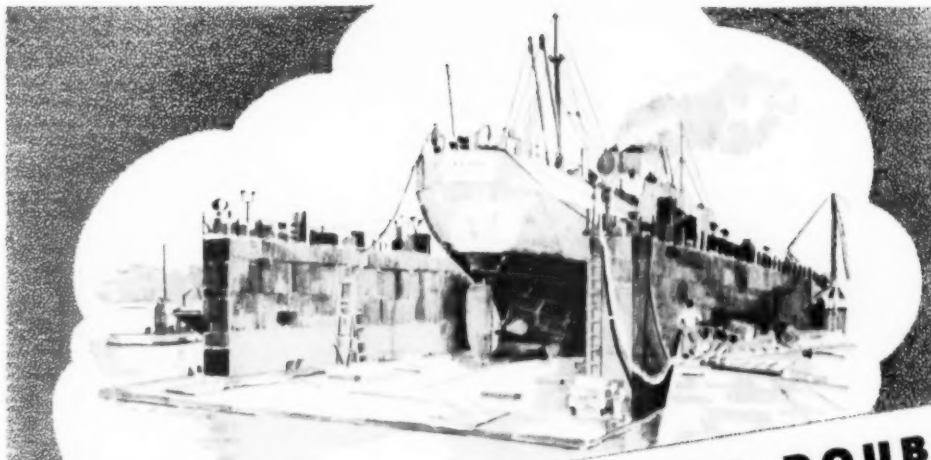
The concrete was selected over timbers because of its greater physical ability to withstand deteriorating forces from waves generated by hurricanes and damage by marine borers plus its resistance to fire.

The battery is located 4 miles from shore and 15 miles from Calco's operating base at Venice, and consists of eight separate 30 by 30-ft. platforms which are grouped and spaced for operating convenience and with respect to fire hazards.

A group of tank platforms support 1,500-bbl. tanks and in addition there is a separator platform, heater-treater platform, and a doghouse platform. The platforms—except for the doghouse—are each supported on four 36-in. by 128-ft. concrete piles.

These hollow piles, which are made up in sections and held together by cables, are placed end to end in much the same fashion as concrete blocks used in house construction are piled one on top of the other. The cables strung through these sections are pulled tight in much the same manner as piano wire and held in place with concrete mortar. This gives a flexibility to permit the piling to withstand surging forces of hurricane winds and waves.

The construction of each platform consists of driving false piles upon which a guide template is installed. The four concrete piles are driven individually with a steam hammer. Then the 30 by 30-ft. precast deck section is lifted as a unit and set in place on the piles.



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ON THE DOUBLE!

Moments are vital to the owner when his ship is in dry dock. For not only does he face a repair bill but his source of income is cut off.

Aware of this, Alexander men cut time-out costs to a minimum. Fast, efficient service, coupled with up-to-the-minute dry dock and repair facilities, get your vessel promptly into service again.

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For complete specifications write for Bulletin 50.

ACCURATE GAS PRESSURE

The RS Standard Dead Weight Gage facilitates testing gas pressures; rock pressure at wells; static pressure on orifice meters and pipe line pressure in locating leaks. The design of the gage is based on the principle of applying pressure by a known weight to a hydraulic piston of known area; and of the converse effect to measure unknown pressure by balancing its force on a piston of known area with a known weight.

THE INSTRUMENT IS CALIBRATED TO INDICATE PRESSURES WITH A PRECISION OF 0.1%.

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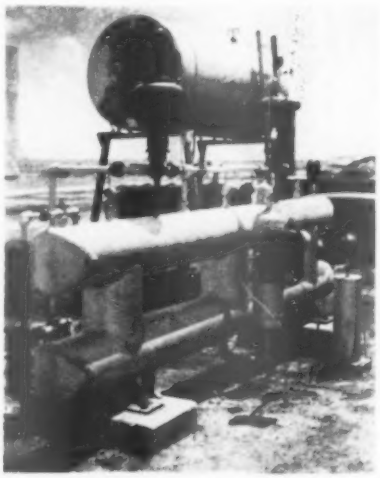
Three-way separator on injection system

A THREE-WAY separator is used on the injection system for dry gas by Gillring Oil Co., Inc., at its Agua Dulce field installations, Nueces County, Texas.

The unit, composed primarily of parts on hand, is used to receive liquid from low-pressure separators and then send this liquid into a high-pressure line to the nearby cycling plant.

The three-way separator volume tank consists of two horizontal tanks made from line pipe and three risers connecting the two tanks in one complete unit. Connected to the upper tank are two 1-in. risers which tie in to a horizontal gas line. This line has two kidney valves installed along it to control flow of gas in the system.

Two other lines run downward from the lower tank, one of which is connected to the vertical gas-oil separators on the lease, while the other ties in with main fluid line running to the plant.



Three-way separator used by Gillring Oil Co., Inc., at Agua Dulce field in Texas to receive liquid from low-pressure separators and to send this liquid into high-pressure line to cycling plant.

The gas-oil separators operate at a pressure of 700 psi. to remove liquid from repressuring gas prior to its entering the suction line of the compressor unit used to repressure the field. The liquid thus removed is allowed to gravitate into the three-way separator. A liquid-level controller is used to actuate the two kidney valves so that when the liquid level is low, the valves are positioned so that the gas line across the top of the unit is open to the separators, thereby equalizing the pressures and allowing liquid to gravitate into the three-way unit.

As the liquid level rises, the regulator acts to cause the valve on the gas line to the separator to close while the valve on the other end of the gas line opens. This allows gas from the compressor, at a pressure of 2,000 psi., to enter the three-way unit thereby forcing liquid collected out into the main line, which operates at a 1,200-psi. pressure.

When enough liquid has been evacuated from the unit, the regulator then causes the two valves to reverse their action, cutting off the high-pressure gas and allowing the three-way unit's pressure to equalize with that of the separator and flow of liquid between separators is resumed. Check valves are positioned at appropriate places in the flow lines to prevent the system from getting out of balance.

The unit was developed by L. C. Smith, vice president for Gillring at Banquete, Tex.

RED DEVIL

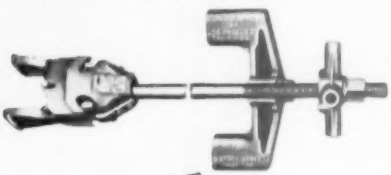
"DIA-HARD" Slush Pump Liners

High Hardness and High Carbon The Combination for Longer Life

Maximum wear resistance results from the combination of *high hardness* and *high carbon*, not from high hardness alone. The deep wear resistant case of Red Devil "Dia-Hard" liners has a uniform *hardness* of 62-64 Rockwell "C" and a uniform *high carbon* content in excess of 1.00%. This combination of a case of high hardness and abrasive resistant carbides with a core of high tensile strength and ductility is obtainable only by our special "Dia-Hard" process.

Integrally forged liner glands; precision honed bore. Outside dimensions are accurately machined assuring perfect working fits with liner packing assembly and pump cylinder for positive sealing against modern high pressure pump operation.

Write for Price Catalog No. P-120.



TELL-TALE LINER PACKING ASSEMBLIES

Give warning before pump damage

Tell-Tale Liner Packing Assembly consists of two "Dia-Tex" oil and heat resistant sealing rings separated by a precision machined corrosion-resistant steel lantern ring. Internal leakage is detected instantly through the tell-tale hole before costly fluid cuts can damage the slush pump. For information on Red Devil Tell-Tale Packing Assembly or "Dia-Tex" Liner Sealing Rings *write for Price Catalog No. P-121.*

LINER PULLERS

The Red Devil Liner Puller is a strong, heavy duty tool capable of pulling the most obstinate liner. Simple in operation, there are no pins, connecting links or other small parts to bend, shear, break or lose. Two Types: "Universal Type" (as illustrated) for slush pumps, the "Expanding Grip Type" for pulling thin wall tube-type liners in small pumps. *Write for Price Catalog No. P-122.*

Consult Composite Catalog

for full information on Red Devil Products or write for price catalogs. Red Devil Products are available through your supply store.

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What Mr. Tubes Can Do For You

—about pressure tubing

When it comes to pressure tubing, you're wise to talk to somebody who knows your problems. Mr. Tubes, your nearby B&W Tube Representative, serves the oil, chemical and power industries . . . and related fields . . . faithfully and efficiently. He is constantly concerned with tubing problems his customers encounter, and he devotes a lot of his time to helping find the right answers to questions of pressure and temperature.

Mr. Tubes can do a lot for you. Next time pressure tubing is on your mind, call on him.

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THE BABCOCK & WILCOX COMPANY
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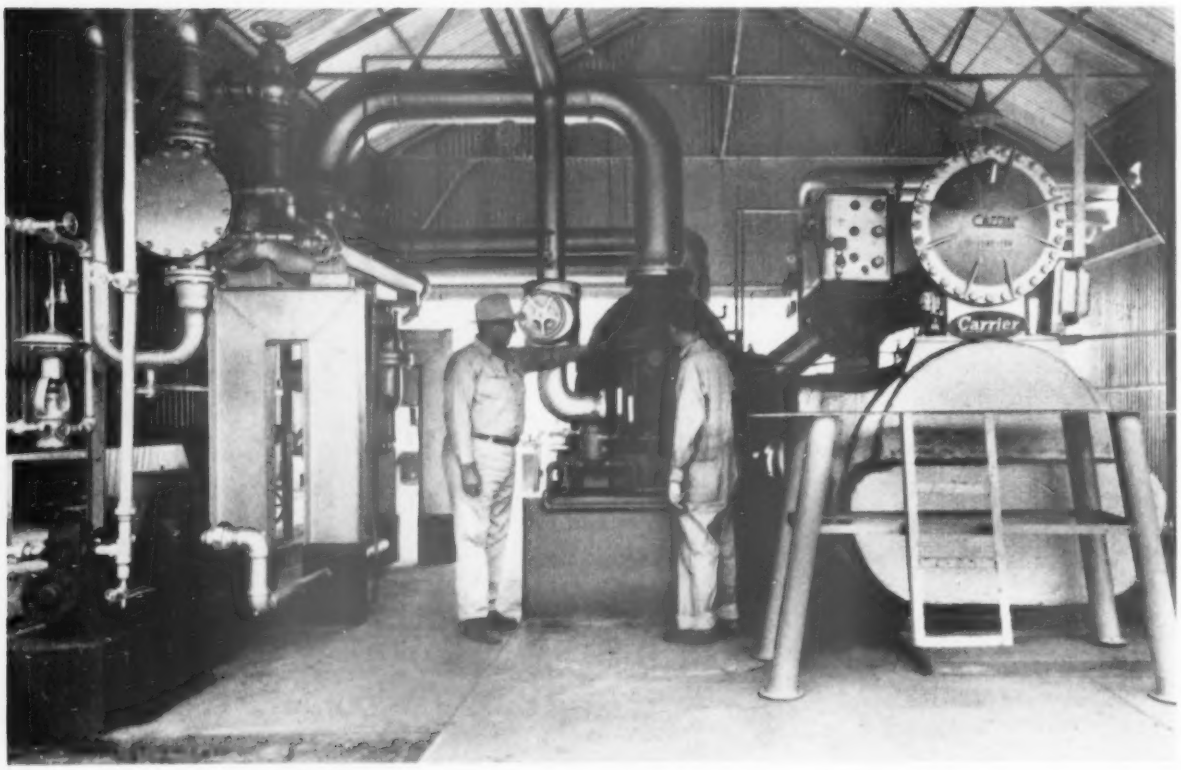
TA-1802(1)

centrifugal refrigeration

increases propane recovery by 10% at Warren Petroleum

When refrigeration of lean oil can boost propane-butane recovery by 7000 gallons a day, that's news! ▪ Well, it happens every day at Warren Petroleum Corporation. Says Warren's superintendent: "Our Carrier refrigeration unit increases propane extraction by 10%, butane extraction by 7%." ▪ An added plus is the low operating cost of the Carrier Centrifugal. Lower absorber pressures save gas compression. Lean oil circulation is reduced. There are resulting economies in distillation and stripping. ▪ These rugged, highly efficient Carrier machines (like the centrifugal illustrated here at Warren) are made for hard,



round-the-clock operation in refineries and gas plants. They need no housing. They're compact and fit easily into existing installations. ▪ Carrier Centrifugal Refrigeration Machines are available in capacities up to 3000 tons to chill liquids or condense vapors—with safety and reliability. And Carrier's nationwide service is as near as your telephone. There's a factory-trained centrifugal specialist at every Carrier district office. ▪ Carrier has been serving American industry for over 50 years. May we assist you? Look for Carrier in the Classified Telephone Directory. Or write to Carrier Corporation, Syracuse, New York.

Carrier

centrifugal compressors
refrigerating equipment

EQUIPMENT MEN . . . in the News

Sales Appointments Named By Byron Jackson Co.

R. J. EVANS, JR.

B. A. Hilliard, general sales manager, Byron Jackson Co., oil-tool division, recently announced the appointment of R. J. Evans, Jr., as assistant regional sales manager, oil-tool division, and special representative for BJ Service, Inc., with headquarters in the company's Mid-Continent regional sales offices at Fort Worth. Evans was formerly district manager at Oklahoma City.

O. J. FILE

J. O. HANKINS

Appointed to succeed Evans, as district manager, in Oklahoma City is O. J. File, who was formerly BJ sales representative at Wichita Falls.

J. O. Hankins, formerly sales representative in West Texas, has been appointed to replace File at Wichita Falls.

L. B. Roberts Forms New Materials Handling Firm

Lewis B. Roberts, formerly with Cant Manufacturers Representatives, Tulsa, has purchased the entire assets of Cant Manufacturing and has organized a new company to be known as Materials Handling, Ltd., also located in Tulsa.

Cant had represented many manufacturers of materials handling equipment for over 20 years in the Tulsa area. The new firm will take over the lines formerly represented by Cant and will offer a complete line of materials handling products and service covering all problems concerned with the interplant transferral of raw and finished materials.

Materials Handling will offer the consulting services of a professional consulting engineer, to aid in design and selection of handling equipment.

Among the many firms whose equipment will be handled by the new firm are: Baker-Raulang Co., Alvey-Ferguson Conveyor Co., Nutting Truck & Caster Co., and Hemco Manufacturing Co.

Glitsch & Sons Holds Annual Sales Conference

Fritz W. Glitsch & Sons, Dallas, manufacturers of pressed-steel products for the petroleum and chemical industries, held its annual sales conference recently at the home office and plant. In attendance were, lower row: Robert W. Fowler, general sales manager, Dallas; S. C. Higginbotham, Los Angeles; B. A. Ross, Dallas; W. R. Greenman, Chicago, and Fritz W. Glitsch, Jr., secretary-treasurer, Dallas. Top row: M. C. Glitsch, vice president, Dallas; Fritz W. Glitsch, Sr., founder, Dallas; Hans C. Glitsch, president, Dallas; K. E. Luger, Houston; R. L. Allen, Cleveland; G. W. Lindskog, New York, and J. J. Tunno, Tulsa.

Perforating Guns Extends Oil Operations to Germany

HANS NIELSEN

Paul Charrin, president of Perforating Guns Atlas Corp., has announced extension of the company's logging, perforating, and core-sampling operations to Germany's oil fields.

Charrin, recently returned from Germany, reports that P. G. A. C. has organized an affiliate company, the Atlas Deutsch-Amerikanische Olfelddienst G.m.b.H., for operations in Germany. The company's headquarters and laboratories have been established in the city of Kiel.

E. W. DRESSLER

H. JANSSEN

J. E. Castel, executive vice president of P.G.A.C., upon his recent return from Kiel to launch field operations, said that Dr. Hans Nielsen had been appointed general manager of the affiliate company. Dr. Nielsen has been active in the oil fields of Germany for many years and is well known for his research work abroad.

Another member of P.G.A.C.'s affiliate staff at Kiel is Erich W. Dressler, a graduate in 1927 from Bresleau Technische University with the degree of Diplom-Ingenieur. P.G.A.C. brought Dres;ler to Houston last January to acquaint him with the company's operations in the United States and Canada.

Dr. Hermann Janssen is also a member of the Atlas executive staff at Kiel. He received his Ph.D. degree in mathematics and physics in 1933 from University of Kiel.

Atlas Deutsch-Amerikanische Olfelddienst G.m.b.H. is the second affiliate company established by Perforating Guns Atlas. Its Canadian oil-field operations have been handled for some years through an affiliate company, Perforating Guns of Canada, Ltd.,

Excerpt from field report:
"Some time ago we decided to install Axelson Duax liners and heavy chrome plated, pin-end, grooved plungers in a number of our extremely tough wells. We are now getting approximately 500 per cent longer pump runs."

Chosen first . . . to last **AXELSON**

PETROLEUM PUMPING EQUIPMENT

THERE IS NO ECONOMICAL SUBSTITUTE FOR QUALITY

AXELSON MANUFACTURING COMPANY • Division of Pressed Steel Car Company, Inc. • PLANTS — Los Angeles 58, California; St. Louis 16, Missouri. • OFFICES — New York City 7, New York; Tulsa 1, Oklahoma; Buenos Aires, Argentina. • DISTRIBUTORS — Jones & Laughlin Steel Corp., Supply Division; Great Northern Tool & Supply Co.; Industrial Agencies Ltd., San Fernando, Trinidad, B. W. I.; Industrias Waldrip & Campbell, Barcelona, Caracas and Maracaibo, Venezuela; Sociedad Comercial de Materias Primas Limitado, Rio de Janeiro, Brazil; Wells Fargo & Co., Express, S.A., Apartado Postal 361, Mexico, D.F.; Dominion Oil Field Supply Co., Ltd., Calgary, Canada.

paired FOR *performance*

AXELSON

pin end, grooved plunger (chrome plated)

Design permits maintenance of a uniform outside diameter of the plunger from end to end, thus providing good protection against the introduction of abrasive material between the plunger and liner walls. *Chrome plated* plungers (used in many installations where abrasion occurs to any degree) provide exceptional resistance to most corrosive conditions. The low coefficient of friction of chromium makes it ideal for use with all types of liners and regular and hardened steel barrels.

Chromium is plated to a greater thickness on groove shoulders and shoulders of pin-end.

AXELSON

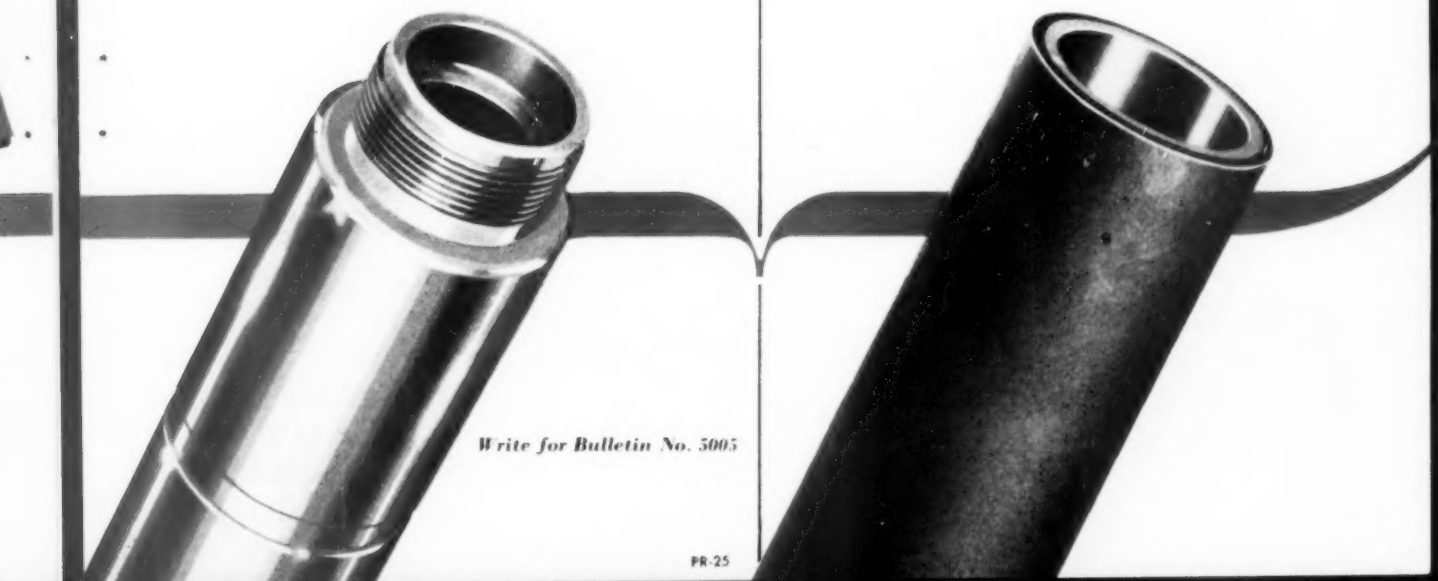
dual-metal Duax liner

The Duax liner stands in a class by itself for sheer strength and resistance to corrosion. The black coating of the tough steel outer shell has lubricating properties which increase the resistance to corrosion and minimize galling of end-faces when liners are assembled. This remarkable iron-and-steel liner is unusually resistant to splitting, yet its alloyed iron wearing surface is hardened to a degree once thought impractical. The secret of its success lies in Axelson's method of:

(a) alloying the iron;

(b) spin-casting the iron into its steel shell to get perfect bonding;

(c) hardening and tempering the iron in electric furnaces.



Write for Bulletin No. 5005

PR-25

Any Union You Need

. . . when you need it!

Here's the world's most complete selection of unions, developed to fill your every need, and kept convenient at central stocking points or at your supply store.

No other manufacturer of unions makes available such a complete range of sizes and types, in all pressure ratings. From the tiny ⅛" hex nut, through the wing nut and misaligning unions up to the big pipeline blank caps, YALE'S line is *complete,* permitting you to standardize on YALE Unions all the way, in every field, on every application. You get the advantage of a single source of supply, complete interchangeability between comparative component parts, *plus* superior performance inherent in the YALE design.

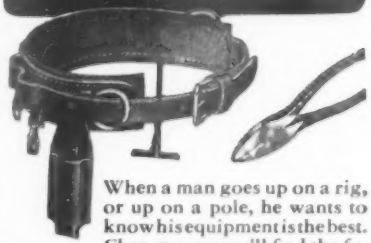
YALE MACHINE WORKS

P. O. BOX 10117
TELEPHONE ME-4282
HOUSTON, TEXAS

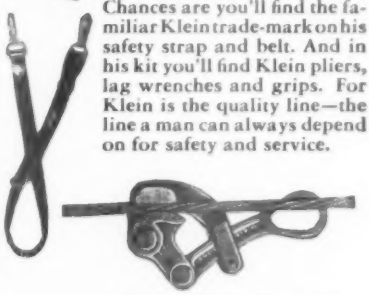
EXPORT: R. S. Stokvis & Sons, Company, Inc., New York, N. Y.

KLEINS

Quality A MAN CAN DEPEND ON



When a man goes up on a rig, or up on a pole, he wants to know his equipment is the best. Chances are you'll find the familiar Klein trade-mark on his safety strap and belt. And in his kit you'll find Klein pliers, lag wrenches and grips. For Klein is the quality line—the line a man can always depend on for safety and service.



ASK YOUR SUPPLIER

Foreign Distributor: International Standard Electric Corp., New York

Write for your free copy of the Klein Pocket Tool Guide today!

"Since 1857"

Mathias KLEIN & Sons
Established 1857 Chicago Ill. U.S.A.
3200 DEMUNT AVE. CHICAGO 18, ILL.

which has offices at Edmonton, Calgary, and Stettler, in Alberta Province, and other offices at Swift Current and Kindersley, in Saskatchewan Province.

Cooper-Bessemer Appoints Williamson Branch Manager

WILLIAMSON

The appointment of R. G. Williamson as branch manager of Cooper-Bessemer's district office in Los Angeles has been announced by Stanley E. Johnson, vice president in charge of sales of The Cooper-Bessemer Corp., Mount Vernon, Ohio.

A graduate in mechanical engineering from University of Southern California, Williamson has undergone extensive factory training in both engineering and operation of gas engines, diesel engines and compressors at Cooper-Bessemer's plants in Mount Vernon, and Grove City, Pa.

Security Engineering Promotes Bentson, Patterson

Hal G. Bentson has been promoted to newly created position of chief sales engineer for Security Engineering Di-

H. G. BENTSON

T. H. PATTERSON

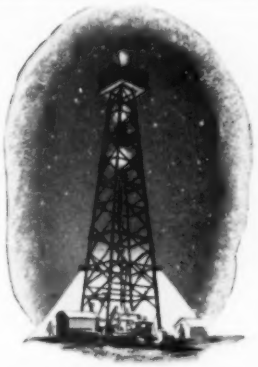
vision, Whittier, Calif., according to an announcement made by Otto Hammer, president of Security.

Bentson was formerly assistant chief engineer for the company. In his new position he will devote a major share of his time assisting oil companies and drilling contractors in solving production problems.

Bentson joined Security in 1938, following his graduation from University of California, where he obtained his degree in mechanical engineering.

In another company release, A. M. Birnie, general sales manager, has announced the appointment of Tommy H. Patterson to the position of assistant division sales manager for Security Engineers' Oklahoma division.

Patterson came to Security in 1948,



KOHLER
ELECTRIC PLANTS
Independent Source of Electricity

Sole Supply... Stand-by Portable and Mobile

Rugged, time-tested service for rig lighting, flood-lighting, maintenance tools on round-the-clock schedules. Heavy duty 5 KW model operates on gasoline or natural gas, has 4-cylinder engine, water-cooled. Other models, 500 watts to 30 KW with or without housing. Stand-by models take over critical loads automatically for refineries when central station power is cut off. Write for folder 4-K.

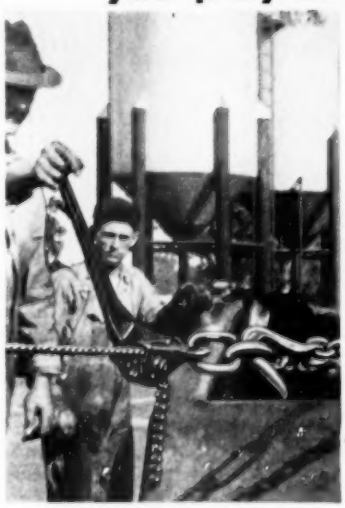
MODEL 5MH2, *5 KW, 115 volt DC. Manual Starting*

Kohler Co., Kohler, Wisconsin. Established 1873

KOHLER OF KOHLER

PLUMBING FIXTURES • HEATING EQUIPMENT • ELECTRIC PLANTS
AIR-COOLED ENGINES • PRECISION CONTROLS

you play it SAFE with Safety-Pulls



Just as important as the time- and labor-saving advantages of Coffing Safety-Pull Ratchet Lever Hoists is the way each one protects your men from injury . . . your equipment from damage. Here's why:

Load cannot slip even if handle is accidentally released — because of dual Ratchet and Pawl principle, developed by Coffing and an outstanding Coffing advantage for over a quarter of a century.

Load is held positively at all times — there is no friction brake to slip or freeze.

Hooks will not break or straighten out.

"Safety-valve" handle will bend before any other part of hoist gives way.

Safety-Pulls are single-chain tested at 100 percent above warranted, rated capacity.

Find out more about how Coffing Safety-Pulls provide extra protection on the job. Write for Bulletin F11SP.

Coffing Safety Pull Ratchet Lever Hoists
2 coil chain models, ¾ and 1½ tons
10 roller chain models, ¾ to 15 tons

Quik-Lift Electric Hoists
Hoist-Alls • Mighty-Midget Pullers
Spur-Geared Hoists
Differential Chain Hoists
I-Beam Trolleys
Load Binders

COFFING HOIST COMPANY
ORIGINATORS OF RATCHET LEVER HOISTS
DANVILLE, ILLINOIS

why you save money when pipe lines are protected with Dearborn NO-OX-ID coating combinations

Before you specify the coating for your next pipe line, check the many reasons "Why" it will pay you to select Dearborn NO-OX-ID Pipe Coatings and NO-OX-IDized wrappers. A Dearborn pipe line engineer is available for consultation.

Dearborn
TRADE MARK
DEARBORN CHEMICAL COMPANY
MERCHANDISE MART PLAZA
CHICAGO 54, ILLINOIS

THE ORIGINAL RUST PREVENTIVE
NO-OX-ID

because NO-OX-ID weighs less

Yes, it weighs less and covers more pipe footage per pound. The result is substantial savings in freight and handling costs.

because NO-OX-ID handles easier

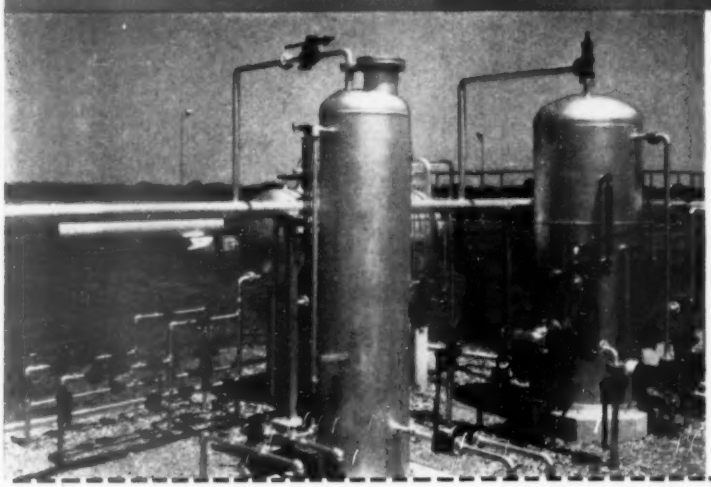
You can coat more feet of pipe per man-hour because less material is required. And, because there are no irritating fumes, pipe line crews prefer working with NO-OX-ID.

because NO-OX-ID requires less equipment

With NO-OX-ID you need less equipment in the field. Fewer "dope" kettles, trucks and "cats" mean reduced construction and labor costs.

because NO-OX-ID lasts longer

Let us demonstrate...with facts, figures and photographs...how Dearborn NO-OX-ID coating combinations give the longest possible life to your pipe line by combining chemical and mechanical protection.



Do you know about NO-OX-ID aluminum protective coating?

To provide maximum protection—and attractive appearance—to outdoor tanks, gas holders, pumps, piping, etc., investigate NO-OX-ID 5C Primer and Aluminum Protective Coating. Highly durable, it resists abrasion, fumes and mild chemical attack. Write for Bulletin.

this complete catalog on superior pipe line protection belongs in your files... MAIL THE COUPON!

Dearborn Chemical Company Dept. OG
Merchandise Mart Plaza, Chicago 54, Illinois

Please send me:
☐ Dearborn Pipe Line Catalog
☐ Literature on 5C Primer and Aluminum Protective Coating
☐ Have a Dearborn Pipe Line Engineer call

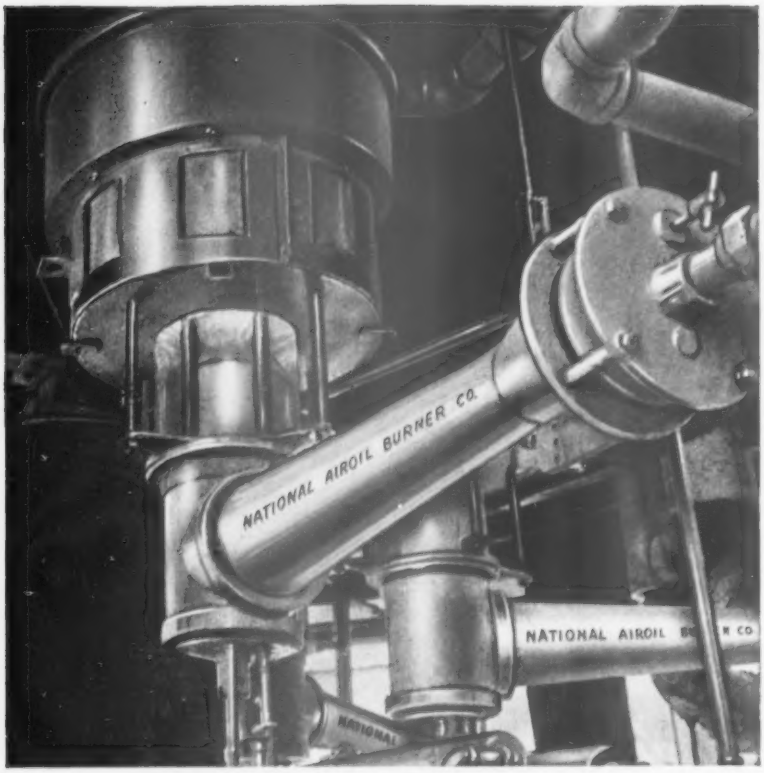
Name.....

Position.....

Company.....

Address.....

City.....*State*.....



FOR VERTICALLY FIRED PETROLEUM HEATERS ONLY

the NEW NATIONAL AIROIL
VERTICAL

Pitch-Oil-Gas Tandem Combustion Units

Exclusively for vertical firing, the new National Airoil VERTICAL Tandem Block Units retain all the features of our regular, well known Tandem Units . . . *plus*: special, pre-cast refractory shapes for easier, cost-saving installation and maintenance; secondary air inlet louvres for positive control of flame pattern; and, all steel duplex detaching gear which enables swift, simple burner changeover.

VERTICAL Tandem Units hold air in the combustion zone until fuel and heated air are thoroughly mixed. This means that ignition takes place in a hot zone; the result: high fuel economy through more rapid combustion with a minimum of excess air. NATIONAL AIROIL'S patented Tandem Combustion Blocks allow secondary air to be easily and accurately controlled. By adjusting air control louvres, flame can be shaped to radiate heat uniformly without tube impingement.

The VERTICAL Tandem Unit is always fired with NATIONAL AIROIL Combination Oil and Gas Burners . . . has a high turndown ratio with a steady flame . . . maintains required flame temperature using either fuel oil or gas. With the TANDEM UNIT'S clean flame, a cold furnace can be brought to full capacity in a short time.

"Many, many more hours *on stream*, without shutdown" . . . yes, YOU will realize higher profits from YOUR heaters when National Airoil VERTICAL Tandem Units are specified. Our new literature is yours for the asking.

NATIONAL AIROIL BURNER CO., INC.

CHEMICAL-PETROLEUM DIVISION
1236 EAST SEDGLEY AVE., PHILADELPHIA 34, PA.
Southwestern Division: 2512 South Boulevard, Houston 6, Texas

INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

working first as a sales engineer and later as district sales manager in Duncan, Okla. Prior to joining Security in 1948 he was sales representative for Great Lakes Corp.

Haynes Equipment Co. Formed at Shreveport

W. M. (Sam) Haynes, formerly district manager of the Republic Supply Co., has announced the formation of Haynes Equipment Co. at Shreveport. The new firm will serve the oil and chemical industries in the Southwest. According to Haynes, the company will specialize in refinery equipment, and will also handle a complete line of oilfield, pipe-line, chemical, and industrial equipment and supplies.

For 17 years Haynes was chief maintenance and construction engineer for Continental Oil Co. at Ponca City, Okla. He later served as engineer for Mathieson Chemical Corp. at Lake Charles, La. In 1943 Haynes was appointed manager of refinery and industrial sales for Republic Supply Co. in Houston. In 1951 he became manager for Republic's Shreveport, ArkLaTex, and South Louisiana districts.

Frontier Chemical Names Clark Vice President

Melvin E. Clark has been appointed vice president, marketing, for Frontier Chemical Co., according to an announcement made recently by Curtis W. Cannon, president. In his new position, Clark will have responsibility for sales, market research, advertising, traffic and other marketing functions. He will make his headquarters at Wichita.

Clark was formerly general product manager, Michigan Alkali Division, Wyandotte Chemicals Corp., Wyandotte, Mich.

Western Co. Opens Pump Station at Cushing, Okla.

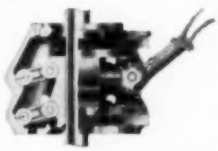
H. E. Chiles, Jr., president of The Western Co., has announced the opening of a new pumping service station at Cushing, Okla.

Western, a technical oil and gas-well servicing company with headquarters in Midland, Tex., will offer both acidizing and fracturizing services from the new location.

W. H. (Bill) Seabolt has been named station manager by Walter Beadle,

SET-UP FOR SPEED and SAFETY

Slip Set. Slip segments are parallel with the centerline of the pipe. Handle is locked in "closed" position.



KINZBACH AUTOMATIC TUBING SPIDER

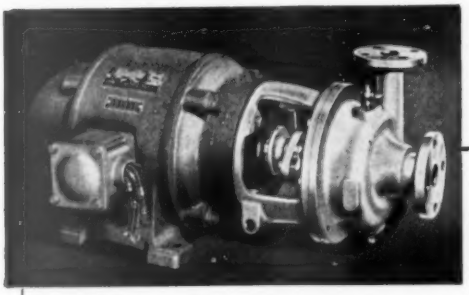
POSITIVE GRIP
AUTOMATIC ALIGNMENT
ONE-MAN OPERATION
FULL SIZE RANGE

The Kinzbach Automatic Tubing Spider handles tubing through 3". It is rated at a 150,000 pound operating load.

For complete information write for Bulletin 23151.

KINZBACH TOOL CO., INC.
P. O. BOX 277 HOUSTON 1, TEXAS
Export Office: 74 Trinity Place, New York, N. Y.

KINZBACH TOOL CO INC



A low-cost answer to many acid-pumping problems!

AMPCO® Centrifugal Pumps

Take the headache out of pumping acids — use Ampco Centrifugal Pumps. Made of Ampco aluminum bronzes, they have exceptional resistance to corrosion. And they also resist the damaging effects of cavitational erosion, deformation, and wear.

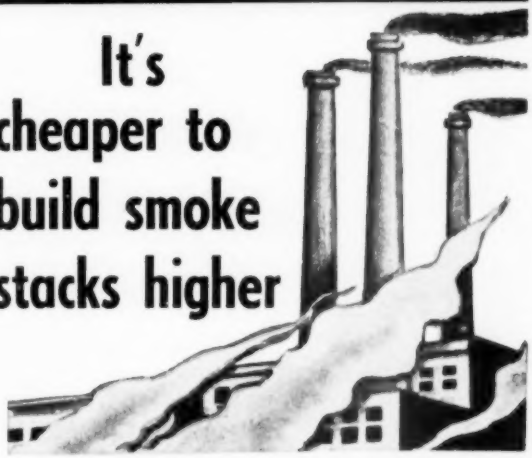
That's why Ampco Pumps are ideal for handling difficult liquids such as hot sulfuric acid, hot acetic acid, hydrofluoric acid, fatty acids — as well as dyestuffs, caustics, brine, and other corrosive liquids.

Best of all, Ampco Pumps *sell at standard pump prices* — even with all their extra advantages. They're available in sizes from fractional flow to 600 gpm — with close-coupled or pedestal mounting. Write for more information today.

AMPCO METAL, INC.
Department OG-11 • Milwaukee 46, Wis.
West Coast Plant: Burbank, California
*Reg. U. S. Pat. Off. P-6

AIR POLLUTION

It's cheaper to build smoke stacks higher



..if you know the meteorological facts

Why did a smelter in the southwest first build its smoke stack 200 feet high . . . then raise it to 350 feet . . . and then raise it again to 455 feet to eliminate SO^2 pollution?

Over the years they had learned more from the scientific progress in "stack meteorology" as a practical way to eliminate pollution at ground levels.

They learned the hard way. You can do it the easy way.

5 Basic Patterns of Smoke Behaviour

Meteorologists studying smoke behaviour under almost all kinds of turbulence, temperature and humidity conditions have come up with some basic answers for forecasting smoke behaviour.

This knowledge applied to your plant location and your air pollution problem will help guide you to the solution on a broad level.

At Bendix-Friez we offer you meteorological equipment that has set the standard of the world for 77-years. We offer too, all the experience of others who have made use of Bendix Friez meteorological equipment in their own problems of pollution.

AEROVANE Indicates and records wind speed and direction. Recognized as "best all-purpose wind measuring instrument yet devised." Readily installed and easily maintained.

HYGRO-THERMOGRAPH The leader in its field. Noted for precise accuracy and long-time dependability. Portable, easy to operate. Widely used in laboratories, factories and offices.

BENDIX FRIEZ

FRIEZ INSTRUMENT
Division of
Bendix Aviation Corporation
1460 Taylor Ave., Balto. 4, Md.

EXPORT SALES
Bendix International Division
205 E.42nd St., New York 17, N.Y.U.S.A.

Threads 4 sizes of pipe *fast* with 1 set of dies—*and it won't jam!*

RIDGID

65R PIPE THREADER

This popular 65R has saved millions of hours of threading time, and no wonder—its one set of self-contained high-speed dies adjust to 1", 1¼", 1½" or 2" pipe size in 10 seconds! Mistake-proof self-centering workholder sets instantly! And lead screw won't jam on workholder, kicks out automatically at standard thread length! You can't match it for fast easy pipe threading —buy it at your Supply House.

THE RIDGE TOOL COMPANY • ELYRIA, OHIO

RIDGID
Work-Saver Pipe Tools

Western's vice president and operations manager. Pumping units and related equipment have been moved into Cushing and services to oil operators in Payne, Lincoln, Creek, Logan, Pawnee, and other surrounding counties are already being offered.

W. W. Wilson and L. O. (Red) Gore will represent Western in sales.

The new station will be a part of Western's North Texas-Oklahoma region with headquarters in Wichita Falls.

New Sales Engineers Named By American Meter Co.

C. B. Dushane, vice president, sales, of American Meter Co., has announced the appointment of two new sales engineers. R. G. Campbell has been

R. G. CAMPBELL

H. H. HOLMES

named a representative with the Los Angeles office of the company, and H. H. Holmes is now a representative of the company in western Oklahoma and Kansas.

Campbell attended University of California at Berkeley and was with Southern California Gas Co. before joining the American Meter organization.

Holmes received a degree in mechanical engineering at University of Texas. After experience with North Electric Manufacturing Co. of Ohio, and Refinery Supply Co., of Tulsa, he joined American Meter Co., Westcott & Greis Division, Tulsa.

Wagner-Morehouse Names Canadian Distributor

Charles D. Wagner, president, Wagner-Morehouse, Inc., manufacturers of mobile oil-well drilling and servicing equipment, recently announced the appointment of Eastman Oil Well Service Co., Ltd., Calgary, Alta., Canada, as exclusive distributors for all W.-M. equipment in Canada. Eastman also maintains warehouses and service facilities at Edmonton, Alta.; Dawson Creek, B. C.; Regina, Sask., and Weyburn, Sask. Additional warehouse and service facilities will soon be available in Virden, Manitoba, and Swift Current, Sask.

Wagner-Morehouse specializes in the design and manufacture of complete

EFFICIENT, CLEAN,

DEPENDABLE ...LOW COST

PURCHASED

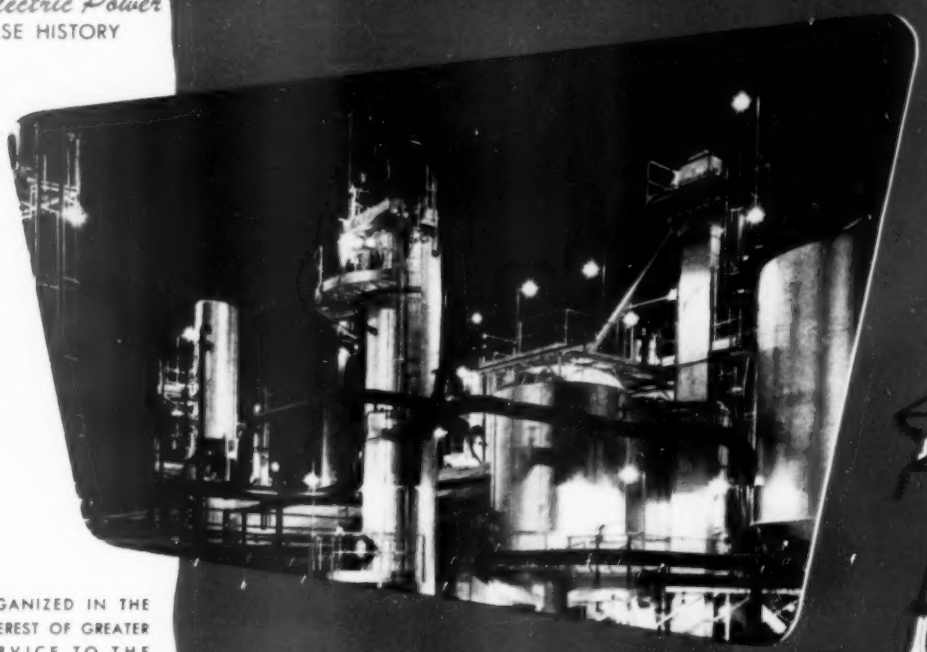
Electric Power

IS ON THE JOB!

The labor saving efficiency of Low Cost Purchased Electric Power has proved that Electric Power is the answer to power problems in all phases of refinery operations. Electric Power is also proving its values in every phase of the Oil Industry, including Pumping, Crude Oil and Gas Transmission Lines, Pipeline Stations, Water Flooding Operations, etc. Year after year, you'll find Low Cost Purchased Electric Power proves superior in every way. Go 'PEP . . . You'll see. Call your Power Engineer . . . TODAY!

'PEP — Purchased Electric Power.

ANOTHER
Electric Power
CASE HISTORY



ORGANIZED IN THE INTEREST OF GREATER SERVICE TO THE PETROLEUM INDUSTRY

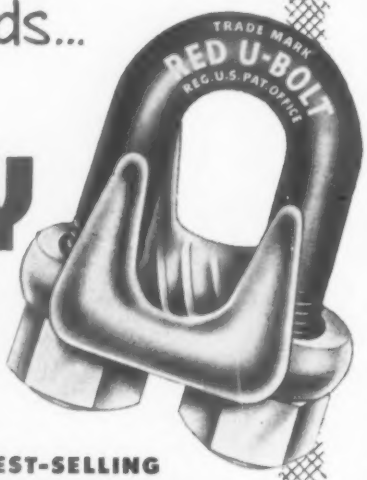
PETROLEUM ELECTRIC POWER ASSOCIATION

CALL YOUR NEAREST ELECTRIC SERVICE COMPANY
FOR MORE FACTS OR ADDRESS YOUR REQUEST
TO P. O. BOX 2771, DALLAS, TEXAS

Our 25th Year

To protect lives and loads... use

CROSBY CLIPS



AMERICA'S LARGEST-SELLING
DROP-FORGED WIRE ROPE FASTENERS
MADE BY AMERICAN HOIST & DERRICK CO., ST. PAUL 1, MINN.
Authorized Distributors Everywhere

HIGH CAPACITY
Lightweight PUMPS

2" Gorman-Rupp pump in Field Processing Plant Construction job.

MIDGET 1½"

PELICAN 2"

HAWK 2"

EAGLE 3"

QUICKEST PRIMING — *HIGHEST* PRIMING
FASTEST PUMPING — *NON-CLOGGING!*

Built for hard service. Five years without repair — three months' continuous runs without shutdowns, are not uncommon. Saving in time alone repays their cost to many users in the petroleum industry.

Lightweights range in size from 5,500 to 18,000 G.P.H.

Ask for bulletin 7-LW 13

Mid-Continent and Gulf Coast Oilfield Representative
HENRY H. PARIS DISTRIBUTOR, INC.
1125 ROTHWELL STREET, HOUSTON, TEXAS

A COMPLETE LINE OF CENTRIFUGALS IS AVAILABLE UP TO 240,000 G.P.H. CAPACITY.

THE GORMAN-RUPP COMPANY
MANSFIELD, OHIO

mobile integrated drilling units and oil-well servicing units, including all necessary components.

Capt. J. E. Treacy is vice president of Eastman Oil Well Service Co., Ltd., and is well known throughout Canadian oil fields.

Oil Metering Names Wittich Export Representative

V. R. WITTICH

Val R. Wittich, Jr., has been named exclusive export representative for Oil Metering & Processing Equipment Corp., as announced by Vernon Smith, president.

Wittich, whose offices are in New York City, has been representing manufacturers of drilling, production, and refining equipment since 1926. His associates are Fred J. Jobst, Clay H. Hesse, and Earl Fuller.

Tube Turns Names Burke, Muir to New Sales Posts

Tube Turns, Inc., Louisville, has added Richard T. Burke, a sales engineer, to its Houston staff, and Earl R. Muir, Jr., a sales engineer, has been assigned to Seattle.

Burke joined Tube Turns in 1949 and originally was stationed at Midland, Tex. He attended Massachusetts Institute of Technology.

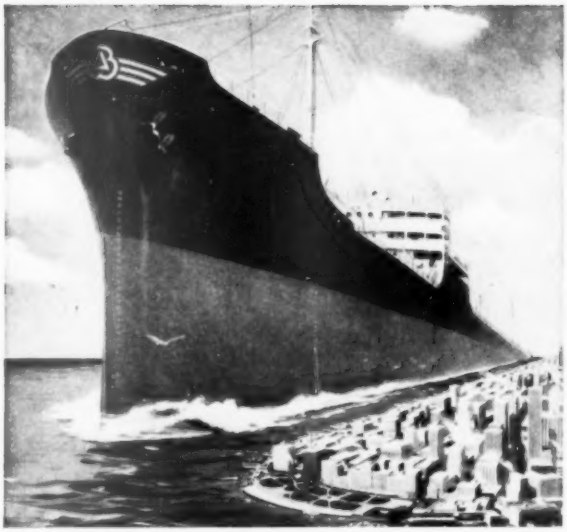
Muir joined Tube Turns in 1943, and was a member of the staff of the San Francisco office prior to his new assignment. Muir will expedite service to the company's Northwest distributors, and to the area's users of industrial piping systems.

Carlon Products Appoints Southwest Representatives

Carlon Products Corp. recently announced the appointment of Ivan P. Kinder as field engineer to specialize in Carlon plastic pipe applications in the petroleum industry. Carlon also announced the appointment of Clifford L. Lemon and James D. Cleminshaw as sales representatives in the southwestern territory.

Kinder was formerly associated with the Green Contracting & Engineering Co. of Wichita, Kans., and has had wide experience in the sale and installation of plastic pipe in the oil fields.

Lemon formerly represented Carlon in the East out of Silver Springs, Md.



Who needs a tanker 45 MILES LONG?

In 1952, the Cities Service tanker fleet transported 52,540,000 barrels of crude oil and product. To handle that cargo, in one load, would have required a tanker at least 45 miles long.

A ridiculous idea? Of course . . . but it provides a graphic illustration of the amount of petroleum products moved *on water alone*, by a *single company alone*, in a *single year*. It paints for the eye a picture of part of the tremendous job one oil company, Cities Service, is performing in its endeavor to produce, refine and market the world's finest petroleum products for the American consumer, in quantities that permit them to be priced within his easy reach.

The Cities Service Oil Company is proud to be one of the top members on the team of the American petroleum industry . . . an industry that is today doing the greatest job in its long and exciting history under handicaps that are greater than ever before.

CITIES SERVICE
QUALITY PETROLEUM PRODUCTS

An Important part of the American Oil Scene

There's Only ONE WAY to figure STEAM TRAP COSTS

Purchase Price
+Installation Cost
+Maintenance Cost
Total Trap Cost

on this basis SUPER-SILVERTOPS are always your BEST BUY!

● All good steam traps cost about the same . . . on the shelf. But there's a big difference in their price when you figure installation and maintenance costs. Because there are 75% fewer threaded joints required with the simplified piping of Anderson Super-Silvertops, 75% less installation time is required.

75% LESS INSTALLATION TIME
because Super-Silvertops can be installed straight-in-line or as an elbow.

LESS MAINTENANCE is needed with Super-Silvertops. They have long-life Anderloy valve and seat—large, smooth drilled passages that seldom clog—guided bucket for positive valve closing to prevent bucket damage.

50% LESS MAINTENANCE
as Super-Silvertops are easily serviced without disturbing a single pipe-fitting.

Cut your steam trap costs to the bone. Save on installation and maintenance costs by installing Super-Silvertops. Mail coupon for free catalog, "Solving Steam Trap Problems" and prices.

THE ENGINEERED STEAM TRAP

THE V. D. ANDERSON COMPANY
1981 West 96th St. • Cleveland 2, Ohio

Please send free copy of "Solving Steam Trap Problems" and prices on Super-Silvertop Steam Traps.

Name ..... *Title* .....

Company .....

Address .....

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CAMPBELL CHAIN

Makers of Famous *Lug-Reinforced* TIRE CHAINS

Lemon now headquarters in Houston, and will be responsible for Carlon sales in South Texas and Louisiana.

Cleminshaw has been appointed Carlon representative out of the Fort Worth office and will cover North and West Texas, Oklahoma, and Arkansas. He was previously associated with Carlon at the general offices in Cleveland.

McClatchey to Manage Beacon's Tulsa Branch

E. C. Sidwell, president, Beacon Supply Co., headquartered in Pampa, Tex., has announced the appointment of O. E. McClatchey as manager of the Tulsa branch office.

McClatchey has been associated with the oil business for many years having served as president of the Purchasing Agents Association in Tulsa and as vice president of the National Purchasing Agents Association. For the latter group McClatchey acted as chairman of the oil-company buyers group on the project to simplify and standardize oil-company tubular goods.

Oil Well Names Yochum Assistant Manager

The appointment of W. G. Yochum as assistant to manager, tubular department, of United States Steel's Oil Well Supply division, has been announced by Fred F. Murray, president.

Yochum was first employed in 1922 by the National Tube Co. of United States Steel and transferred to Oil Well in September 1935 as assistant office manager of the tubular department located in Pittsburgh. Yochum subsequently became office manager of the tubular department, the position he held at the time of his new appointment.

Lane-Wells Co. Advances Rutledge, Bush at Houston

In furtherance of Lane-Wells Co. extensive customer service program, two executive appointments are announced in the Gulf Coast division by Rodney S. Durkee, president.

R. M. Rutledge, formerly division sales manager, has assumed new duties as assistant to the division manager, and R. E. Bush, assistant division sales manager, has been made sales manager of the division.

The Lane-Wells customer service program is designed to equip every Lane-Wells man with the broadest possible knowledge and experience, in order to maintain and improve the company's service to the oil-producing industry.

Sid Richardson Appoints Wilson to Akron Sales

D. P. WILSON

Frank Andrews, vice president of Sid Richardson Carbon Co., recently announced the appointment of Dawson P. Wilson as a sales representative with headquarters at Akron.

Upon Wilson's graduation from University of Illinois in 1928, he was employed by B. F. Goodrich Co. In 1935 he became associated with Firestone Tire & Rubber Co., where he has been employed until his new association.

Harnischfeger Corp. Promotes Catalane

Harnischfeger Corp. has announced the appointment of J. F. Catalane as sales manager of the P&H small excavator division. Catalane succeeds F. C. Edwards, recently appointed general manager of the P&H diesel division, located at Crystal Lake, Ill.

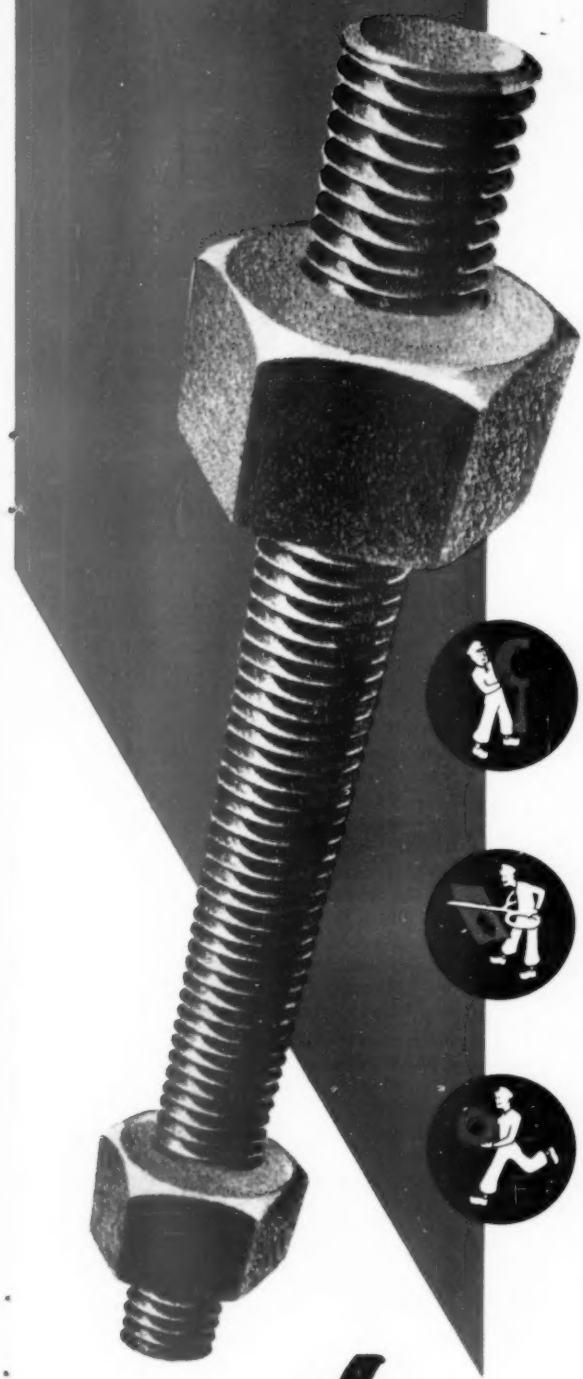
Catalane began his career with Harnischfeger in 1945, as a salesman in the New York district office. In July 1950 he took over the Upper New York territory, at which time Syracuse was made a district office. He was in charge of sales in the area for the entire line of P&H products.

Concurrent with Catalane's appointment, Robert P. Jones will assume the duties of assistant sales manager of the small-excavator division. Jones has previously been with P&H in a sales development capacity for the soil stabilizer division.

Caterpillar to Locate Parts Depot in Denver

A new parts depot for Caterpillar Tractor Co., Peoria, Ill., will be located in Denver, according to Don Gilbert, parts depots manager. The new depot is expected to be in operation about February 1, 1954, which will improve parts service for approximately 14 Caterpillar dealers in Colorado, New Mexico, Wyoming, Utah, Texas, and Montana.

The depot will carry a full inventory of Caterpillar parts in a 40,000-sq. ft. building now under construction. Caterpillar operates other parts depots in Spokane, Wash.; San Leandro, Calif.; Kansas City, Mo.; St. Paul, Minn.; Shreveport, La.; Indianapolis, Ind.; Albany, N. Y.; and Atlanta, Ga.



Dutch industry makes American standard fasteners for the oil industry

QUALITY Five ultra-modern Dutch factories are banded together to produce the world-renowned VvS nuts and bolts made to American specifications. The fasteners industry of Holland has led in efficiency, dependability and precision for more than 100 years. The quality of Dutch VvS products is unsurpassed. Leading U. S. testing laboratories certify the quality of VvS products on *American standards* of metallurgy, dimensions and finish. For example, the oil industry in the United States and Canada is widely using Heat Treated and Oil Quenched VvS nuts. These products meet ASTM specifications A-194 of course, and are particularly outstanding in finish.

PRICE Dutch efficiency and dependability make it possible to supply VvS nuts anywhere in the world on a competitive basis. The oil industry has used fasteners from the VvS member factories since its very beginnings. American oil and gas industry purchasers of nuts, bolts and fasteners are invited to compare VvS price lists with any others.

DELIVERY VvS factory organizations take pride typical of the Dutch in their ability to meet delivery deadlines. Orders placed with Reynolds Fasteners, Inc., in America bring fast and dependable shipments from the stable VvS plants, where technician, craftsman and workman alike are given opportunities, incentives and working conditions ranking with the best Europe can offer. Plants and equipment facilities are being enlarged in pace with the steadily growing stream of business coming to VvS.

The exclusive Sales and Service Representative for VvS in the United States and Canada is

Reynolds FASTENERS, INC.

VvS

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Phone DIgby 4-7444
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In Canada associated with
Kenway Metal Products, Ltd.
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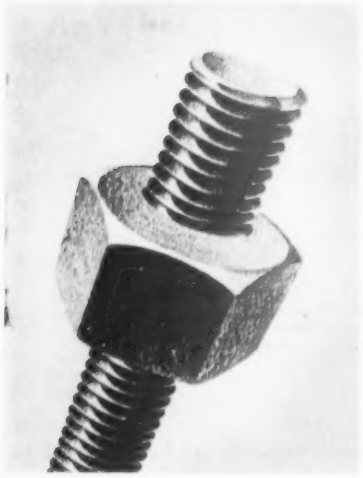
Toronto 1, Ontario

(See next page)

Reynolds FASTENERS NEWS



ABSOLUTE QUALITY STANDARDS

VvS fasteners for the American oil and gas industries are produced strictly in line with ASTM standards as to metallurgy, dimensions, finish. Their qualities are verified by leading U. S. independent testing laboratories. American stud manufacturers are giving immediate and wide acceptance to VvS nuts of both Classes 2 and 2H. Their absolute quality is enhanced by unrivalled finish, including true washer surface and smooth outside surfaces, and a balanced hexagon shape.

VvS quality is the result of Dutch pre-eminence in the fasteners field. The VvS Heat Treated, Oil Quenched nuts are made on the famous Van Thiel hot pressing equipment, acknowledged to be one of the major advances in nut making. VvS craftsmen have the advantage of more than a decade of experience with this and other Dutch-developed equipment.

Currently Reynolds Fasteners is booking orders for VvS nuts in sizes of ¼-inch to 3½-inches. The VvS factories are equipped to supply the American market with *a complete range* of fasteners, including Hexagon Head Cap Screws in both 1020 and 1038 steel, in sizes from ¼-inch to 1½-inches; Hot Pressed Nuts from ¼-inch to 4 inches; Semi-Finished Nuts up to 4 inches; Machine Screws; Machine Screw Nuts; Socket Head Cap Screws, and other standard or special types of fasteners.

So diverse are the facilities of the five Dutch factories that inquiries on any type of nut, bolt or fastener are invited for study and prompt reply.

Do you know what Verkoopkantoor voor Schroefbouten N.V. means?

A workable translation for this marathon phrase, usually shortened to VvS, is *Combined Sales Organization of Bolt and Nut Factories in the Netherlands.*

VvS represents an alliance of virtually the entire Dutch bolt, nut and fasteners industry, a field in which the Netherlands has long been a leader. Five factories operate under the VvS banner, employing more than 2000 persons, each factory organization representing a modern, top-flight producer of fasteners. VvS means Sales and Service effectiveness, insurance of Quality and dependability of Delivery.

The combined sales efforts of the Dutch factories commenced in 1934. For nearly a score of years the teamwork of this precision industry group has earned for VvS the admiration and patronage of the most meticulous manufacturers and fabricators in the world.

ABOUT REYNOLDS FASTENERS, INC. As exclusive representatives for VvS in the United States and Canada, the Reynolds organization brings the American oil and gas industries a solid, nearby link between a pre-eminent supplier industry abroad and the men who establish the requirements and standards for equipment for oil fields, refineries, oil and gas process installations, storage, pipe lines, and distribution. American oil and gas facilities are designed to be the best anywhere. It is to this level of quality that VvS has gauged its production of American standard fasteners.

Reynolds personnel are well grounded technically, intimately informed and up-to-date on the qualifications of the VvS member factories and people. Moreover, the Reynolds people are experts in handling the import of precision products. Reynolds is an affiliate of long established firms which for years have specialized in the import of precision metal and engineering products—the best the world offers for American industry. Reynolds offices in New York, Toronto, Paris and The Hague provide sales and technical services for American fasteners applications anywhere in the world. The Reynolds staff is well qualified for rapid, accurate handling of mill orders which bring shipments direct from European ports to the North American ports of entry and railheads for suppliers to the oil and gas industries.

GETTING IN TOUCH WITH REYNOLDS Your inquiries as to details on VvS fastener products for your individual needs should be addressed to Reynolds Vice President for Sales, Mr. Binem Krygier, at the New York office. Mr. Krygier, a widely experienced and informed engineer, and his staff travel frequently in the oil and industrial capitals of the U. S. and Canada. They will schedule a visit to your office on one of the sales and service itineraries, at your convenience.

ABOUT PRICES Any buyer is very much interested in prices and in the case of items produced abroad wants to know why Dutch-made specialty products offer advantages of their own. Price-wise Reynolds believes the VvS products compete with the best. Further, the exclusive machinery and methods of the Dutch give a particularly accurate and beautifully finished product. The Dutch toolmakers of VvS can't be beat for advanced design and efficiency. If the prices are right, there just isn't any question about quality or delivery. VvS goes to work on a stable, agreed schedule of production and shipments. Reynolds experience with American customers will be laid before you for judgment.

Headquarters of VvS are at Helmond, Holland, where two of the factories are located; the other three factories are at Beek en Donk and Slikkerveer (see map sketch). VvS officials welcome visits of American industrialists at Helmond if you are traveling abroad. Let them know you are coming to see VvS showrooms and headquarters through Reynolds Fasteners, Inc.

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Pipe-Line Construction

PIPE-LINE activity as reported below by The Oil and Gas Journal is compiled from information received from pipe-line companies and contracting firms.

These projects include those planned, proposed, under way, and contracted. Uncontracted projects are indicated by a • preceding the company name.

Crude-Oil Pipe Lines

• **California - Oregon Pipe Line System**—103 miles 6-in., proposed, Crescent City, Calif., to Medford, Ore.

• **Cities Service Pipe Line Co.**—60 miles, 12-in., planned, Houston to Sour Lake, Tex.

R. A. Goodall.—45 miles, 6-in., under way, Little Beaver to Merino, Colo. (To connect with Sterling system).

• **Gulf Refining Co.**—55 miles, 12-in., planned. Bay Marchand to Plaquemines, La.

Gulf Refining Co.—63 miles, 8-10-in., under way, Lea County, New Mexico, to Anderson and Denton fields. 1-54.

Lakehead Pipe Line Co.—635 miles, 30-in., under way, Superior, Wis., to Sarnia, Ontario, Canada. Project managed by Bechtel Corp., Saginaw, Mich.

Superior to Wisconsin-Michigan state line. Mahoney Contr.

Mackinaw City to Red Oak, Mich. Bechtel Corp.

Red Oak via Bay City to International Boundary south of Port Huron on St. Clair River. Conyes Const.

Water crossings of Mackinaw, Saginaw, and St. Clair rivers, Merritt-Chapman & Scott Corp., W. J. Meagher & Sons, Inc., and Midwestern Constructors.

• **Magnolia Pipe Line Co.**—29 miles, 8-in., planned. Midland County, Texas area.

Michi, Inc.—10-in., planned, Highland, Ind. to Kalamazoo, Alma, and Elsie, Mich.

• **Pasotex Pipe Line Co.**—146 miles, 10-in., planned. Snyder to Wink, Tex. 2-1-54.

Phillips Pipe Line Co.—18 miles, under way, gathering lines, northeast area of Andrews County, Texas.

• **Progress Pacific Pipeline Co.**—1,100 miles, 24-in., planned, Odessa, Tex., to Los Angeles, Harbor, Calif.

• **Roosevelt Oil & Refining Corp.**—22 miles, 4 and 6-in., planned St. Helen to Norwich, Mich.

Service Pipe Line Co.—153 miles, 12-16-in., under way, Tioga-Beaver Lodge area to Mandan, N. D. O. R. Burden Const. Corp. Completion date 12-1-53.

55 miles, 4-6-8-in., under way, Tioga-Beaver Lodge area gathering system. C. P. Bartley & Son.

Sinclair Pipe Line Co.—45 miles, 18-in., under way, Panova to Cushing, Okla. O. R. Burden Const. Corp. Completion date 12-53.

• **Sinclair Pipe Line Co.**—20 miles, 12-16-in., planned, Monee to Blue Island, Ill. Completion date 4-54.

Texas New Mexico Pipe Line Co.—52 miles, 10-in., contracted, Dawson County to Basin System. McVean & Barlow.

Texas Pipe Line Co.—34 miles, 6-in., under way, Sour Lake to Port Arthur, Tex. Houston Contracting.

45 miles, 8-10-in., under way, between Erath and Bayou Sale stations. Houston Contracting Co.

65 miles, 4-6-8-12-in., under way, South Louisiana. Panama-Williams.

Golden Meadow to Houma, La. Panama-Williams.

Gathering lines in Leeville, Bay De Chene and Golden Meadow pools. Panama-Williams.

• **West Coast Pipeline Co.**—960 miles, 20-22-in., planned, Wink, Tex., to Norwalk, Calif.

Products Pipe Lines

Augusta Pipe Line Co.—43 miles, 8-in., under way, from Arkansas City to Augusta, Kans. Ray L. Smith & Son, Inc.

Badger Pipe Line Co.—215 miles, 8-10-12-in., begin Spring '54, East Chicago, Ind., to Madison, Wis. (Joint project of Cities Service Oil Co., Sinclair Pipe Line Co., Pure Oil Co., and The Texas Co.

• **H. W. Bass & Sons, Inc.**—152 miles, 4-6-in., proposed. Duval and Live Oak counties, Texas, to Corpus Christi, Tex.

• **Great Lakes Pipe Line Co.**—Proposed, extension 130 miles, Nebraska City to Grand Island, Neb.

Harbor Products Systems—86 miles, 16-in., under way, Woodbury Junction, Philadelphia to Trembley Point, N. J. Construction Service Co. and H. C. Price Co. (Joint ownership of Sinclair Pipe Line Co., Gulf Refining Co., and Texas Pipe Line Co. Completion date 1-54.

• **International Pipe Line, Inc.**—132 miles, 8-in., proposed, Wrenshall to Minneapolis, Minn.

Oklahoma-Mississippi River Products Line, Inc.—75 miles, 12-in., under way, West Memphis, Ark., to White River. Williams Bros. 12-31-53.

Under way, White River to Allen, Okla. River Const. Co. Completion date 6-30-54.

Under way, Allen to Duncan, Okla. River Constr. Corp. Completion date 6-30-54.

• **Phillips Petroleum Co.**—54 miles, 6-in., planned, Goldsmith to Borger, Tex.

52 miles, 10-in., planned, Shell's Brookshire system to Sweeny, Tex.

Standard Oil Co. (Ind.)—243 miles, 10-12 in., under way, Whiting, Ind. to River Rouge, Mich.

Calumet district, Indiana, Morrison Construction Co.

Lake County, Indiana boundary to Colon, Mich., Somerville Construction Co.

Colon to Romulus, Mich. R. B. Potashnick.

Romulus to River Rouge, Mich. R. L. Coolsaet Construction Co.

Sunray Oil Corp.—440 miles, 10-in., contracted, Duncan, Okla., to Mississippi River. Ford, Bacon & Davis. Williams Bros.

• **Triangle Pipe Line Co.**—560 miles, proposed, Arkansas City, Ark., to Covington, Ky., and Nashville, Tenn.

• **United States Pipe Line Co.**—1,799 miles, 22-26-in., proposed, Beaumont, Tex., to Newark, N. J.

Beaumont, Tex., to Memphis, Tenn.

Memphis, Tenn., to Louisville, Ky.

Louisville, Ky., to Newark, N. J.

Laterals to Paducah and Lexington, Ky.

Warren Petroleum Co.—34 miles, 4-in., under way, Lea County, New Mexico. Western Const. Completion date 11-53.

• **Williston Basin Pipe Line Co.**—244 miles, 8-in., proposed, Laurel-Billings, Mont., refineries to Glendive, Mont.

Wolverine Pipe Line System—200 miles, 14-in., under way, Chicago-Toledo-Detroit. (Joint ownership of Shell, Texas, and Cities Service.) Anderson Bros. and Midwestern Constructors, Inc. Completion date 1-54.

East Chicago, Ind. to Kalamazoo River, Midwestern Constructors, Inc.

Yellowstone Pipe Line Co.—(Continental Oil Co., Interstate Oil Pipe Line Co., Union Oil Co., and H. Earl Clack interest) 540

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Turbines
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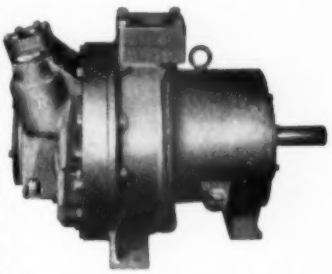

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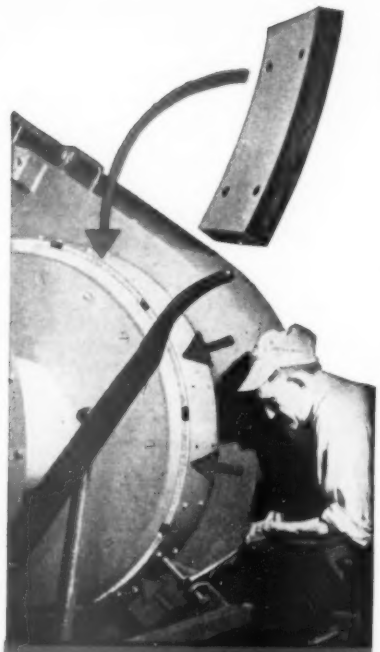

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Thermoid Company, Trenton, N. J.

miles, 10-in., contracted, Billings, Mont., to Spokane, Wash. 9-54.

Billings to Bozeman, Mont. Ross and Powers.

Bozeman to Helena and on to Clinton, Mont. Associated Pipe Line Contractors, Inc.

Clinton to Perma, Mont. Associated Pipe Line Contractors, Inc.

Clinton to Perma, Mont. Eastern Pipe Line Fields Service Co.

Perma, Mont., to Murray, Idaho. Eastern Pipe Line Field Service Co.

Murray, Idaho to Spokane, Wash. Engrs. Limited Pipe Line Co.

Natural-Gas Pipe Lines

• **America-Louisiana Pipe Line Co.**—1,000 miles, 30-in., proposed, Lowry, La., to Detroit, Mich.

• **Arkansas-Missouri Power Co.** — 140 miles, 2 to 10-in., planned, St. Francis River, Clay County, Arkansas, to near Campbell, Mo.

• **Associated Natural Gas Co.**—88 miles, proposed, Missouri.

• **Atlantic Seaboard Corp.**—29 miles, 26-in., proposed, looping along Cobb-Rockville, Md., line.

Buzzards Bay Gas Co.—28 miles, 8-in., contracted, Hyannis, Mass., to Bourne Bridge, Mass. Hallen Co., Inc.

• **Carolina Natural Gas Corp.**—185 miles, 2-12-in., proposed, lateral lines off Transcontinental in North and South Carolina.

• **Chattahoochee Natural Gas Co.**—70 miles, proposed, Floyd County, Georgia to Dalton, Ga.

• **Chicago District Pipe Line Co.**—31 miles, 24-30-in., proposed, East bank of Des Plaines River southwesterly to near Hodgkins Ill., on through Cook County to Will County, Illinois.

• **Cities Service Gas Co.**—18 miles, 16-in. Lawrence and Newton counties, Missouri.

69 miles, 20-16-in., planned, Cleveland, McClain, and Garvin counties, Oklahoma

• **City of Fayette, Ala.**—20 miles, 5-in. proposed, Fayette, Ala., to Southern Natural's system in Tuscaloosa County, Ala.

City of Dallas, Ga.—8 and 4½-in., distribution system. Engineering & Const. Co., 1954.

• **Coast Counties Gas & Electric Co.**—40 miles, 3, 4, and 8-in., planned. Coast and Valley region, California.

• **Colorado Interstate Gas Co.**—365 miles, 22-in., proposed, Green River, Wyo., to Denver, Colo. 1954.

Colorado Interstate Gas Co. — 70 miles, 20-4-in., under way, gas-gathering system in Kansas. Engineering & Const. Co. 1-1-54.

243 miles, 4 to 20-in., under way, Colorado, Oklahoma, Texas, and Kansas. Engineering Const. and Z. J. Graham.

50 miles, 20-in., under way, Hugo to Eads, Colo. R. H. Fulton. Completion date 12-1-53.

• **Cumberland and Allegheny Gas Co.**—31 miles, 12-in., proposed, Garrett County, Md., to Keyser, W. Va.

East Tennessee Natural Gas Co.—96 miles, 16-in., under way, Knoxville, Tenn., to Kent line. Engineering & Const. Co. 1-1-54.

54 miles, 4-12-in., under way, laterals off main line from Knoxville, Tenn., to Kent line. Engineering & Const. Co. 1-1-54.

• **El Paso Natural Gas Co.**—1,178 miles, proposed, Permian basin, New Mexico, Texas and Colorado

El Paso Natural Gas Co.—771 miles, 30-in., under way, Plains, Tex. to Kingman, Ariz.

Section 1—Under way, Plains, Tex., to Corona, N. M. Oklahoma Const. Co.

Section 2—Under way, Corona to Suwanee, N. M. R. H. Fulton.

Section 3—Under way, Suwanee to Gallup, N. M. R. H. Fulton.

Section 4-5—Under way, edge of Navajo

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Styles illustrated

50-00 Jacket 51-00 Pants 53-00 Hat

Protective Clothing by Sawyer

- **Positively not affected by grease, oil or gasoline**
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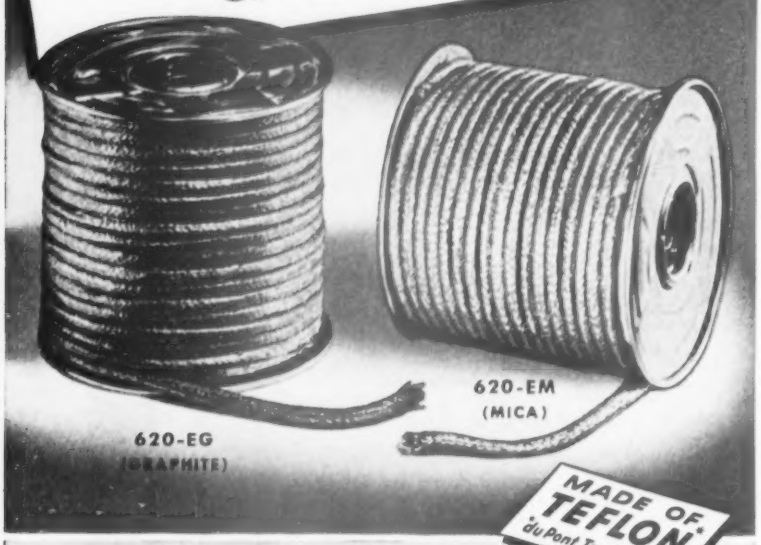

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With screwed or socket weld ends. 3000-lb. and 6000-lb. service.

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Reservation east to Flagstaff on to Kingman, Ariz. Western Pipe Line Const. Inc. Completion date 2-54.

Under way, across Navajo Reservation connecting sections 3, 4, and 5. El Paso Co. crews.

Under way, Spraberry fields, El Paso Co. crews.

• **Fort Worth Basin Gas Co.**—Planned, Novice, through Brown and Comanche counties, Texas.

• **Glacier Gas Co.**—285 miles, 20-in., proposed, Kalispell, Mont., to Spokane, Wash.

120 miles, 16-in., proposed, Spokane to Hanford, Wash.

91 miles, 8⅝-in., proposed, Spokane to Lewiston, Idaho.

130 miles, 12¾-in., proposed, Spokane to International boundary at Trail, British Columbia.

Gulf Interstate Gas Co.—860 miles, 30-in., under way. Acadia Parish, La., to Boyd County, Ky. H. C. Price and Houston Contracting. 11-54.

Under way, Rayne, La. to Kincade, Tenn. Houston Contr.

Under way, Gordonsburg, Tenn., to Catlettsburg, Ky. H. C. Price Co.

230 miles, gathering lines, under way, Associated Pipe Line Contractors, Anderson Bros., Williams Bros.

329 miles, 12 to 24-in., proposed. Laterals off Acadia Parish, Louisiana, to Boyd County, Kentucky, line.

• **Home Gas Co.**—32 miles, 12-in., planned, Breesport to Union Center, N. Y.

17 miles, 12-in., proposed, loops from Hansock to Sanford, N. M.

Home Gas Co.—46 miles, 12-in., under way, Tioga and Broome counties, New York. H. L. Gentry Const.

22 miles, 12-16-in., under way, Binghampton, N. Y.

Houston Pipe Line Co.—43 miles, 24-in., under way, Edna to Wharton main line. Panama-Williams. 12-15-53.

• **Interstate Power Co.**—26 miles, 8-in. proposed, from Nat. Gas P. L. Co. America line near Hooppole, Ill., to Clinton, Ia.

Iowa-Illinois Gas & Electric Co.—41 miles, 10-in., under way, Washington County to Cedar Rapids, Iowa.

• **Kansas-Nebraska Natural Gas Co.**—41 miles, 10-12-in., proposed, Kansas and Nebraska.

41 miles, proposed, Albion, Arcadia, and Broken Bow, Neb.

• **Lone Star Gas Co.**—100 miles, proposed, storage fields to the Dallas-Fort Worth area.

35 miles, 12-in., proposed, southeastern Schleicher County.

36 miles, 12-in., planned, Stamford to Abilene, Tex.

Lone Star Gas Co.—44 miles, 12-in., under way, Red Springs, Woods County to Sulphur Springs area, Hopkins County, Texas.

• **Manufacturers Gas Light & Heat Co.**—40 miles, proposed, Allegheny, Washington, and Beaver counties, Pennsylvania.

213 miles, 3 to 26-in., proposed, various points on system in Pennsylvania, West Virginia, and Ohio.

72 miles, 16-20-in., proposed, Doddridge, Wetzel and Marshall counties, West Virginia.

• **Mississippi River Fuel Corp.**—109 miles. 10-18-in., planned, laterals in Woodlawn and Waskom gas fields, Texas.

Missouri Central Gas Co.—25 miles, 6-in., contracted, Moberly to Macon, Mo. L. R. Young Const. Co.

• **Missouri Public Service Co.**—136 miles, 8-10-in., proposed, New Franklin to Trenton, Mo.

24 miles, 10-in., Johnson County to Clinton, Mo.

• **Montana Power Co.**—52 miles, 16-in., planned, Canada-Montana border to Cut Bank, Mont.

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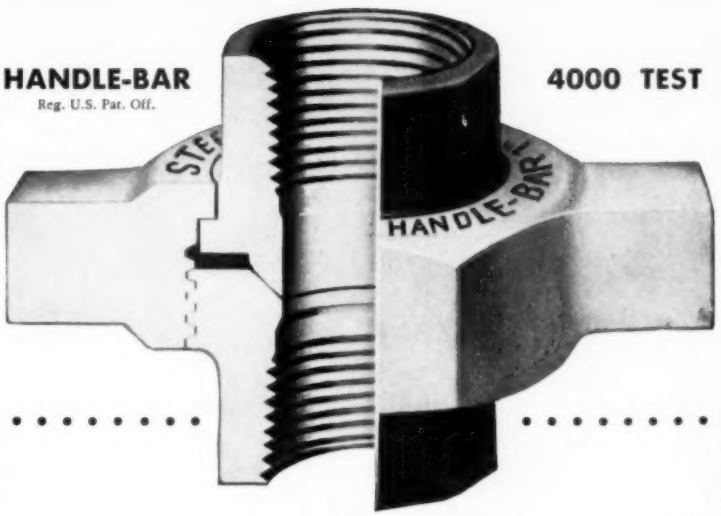

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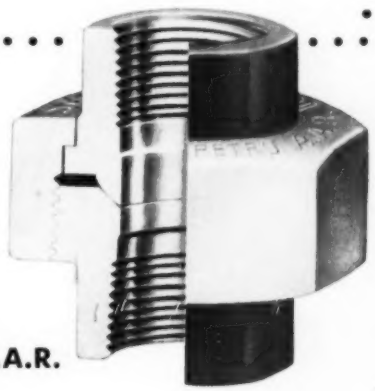

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BARTLESVILLE, OKLAHOMA

• **Morganfield Natural Gas Co.**—31 miles, 4-6-in., planned, through Sturgis, Providence, Clay, Diamond, Wheatcroft, and Sullivan, Ky.

• **Natural Gas Producer Inc.**—100 miles, 12-in., planned, Yenter pool to Denver, Colo.

Nevada Natural Gas Pipe Line Co.—114 miles, 10¾-in., under way, Topock, Ariz., to Las Vegas, Nev. R. H. Fulton.

• **New River Gas Co.**—50 miles, planned, Summers to Monroe counties, West Virginia, to Narrows and Dublin, W. Va.

• **Northeastern Gas Transmission Co.**—22 miles, 8-in., planned, Upton, Mass., to Pawtucket, R. I.

• **Northern Indiana Fuel & Light Co.**—35 miles, 8-in., planned, Edgerton to Auburn, Ind.

• **Northern Natural Gas Co.**—458 miles proposed, Kansas, Texas, Oklahoma, and Nebraska, Iowa and Minnesota to connect with Permian Basin System.

475 miles, proposed branch lines to Iowa Nebraska, Minnesota and South Dakota.

Northern Natural Gas Co.—Section No. 1 92 miles, 30-in., under way, Dumas via Sunray to main line north of Canadian River Texas, and two loops near Beaver station Oklahoma. R. H. Fulton & Co. Completion date 11-53.

Northern Natural Gas Co.—Section 2, 70 miles, 30-in., contracted, loops near Mullinville, Bushton and Clifton stations, Kans. and Palmyra station, Neb. Lone Star Constructors. Completion date 11-53.

Northern Natural Gas Co.—Section 3, 94 miles, 24-in., and 30-in., contracted loops near Paulina, Ogden, and Oakland stations, Iowa. G. G. Griffis Construction Co. Completion date 11-53.

• **Northwest Alabama Gas District**—40 miles, 9-in., proposed, Southern Natural's line through Winfield to Haleyville, Ala.

• **Northwest Natural Gas Co.**—750 miles, planned, Washington, Oregon, and Idaho.

24-in., Eastport, Idaho, to Monroe, Wash.

18-in., Monroe to International boundary near Lynden, Wash.

22-in., Monroe to near Seattle, Wash.

20-in., Seattle to Portland, Ore.

• **Ohio Fuel Gas Co.**—31 miles, 20-in., planned, Licking County to Richland County, Ohio.

22 miles, 16-in., planned, Dayton, Troy, Piqua, and Sidney, Ohio.

23 miles, 16-20-in., planned, Wellington to Elyria, Ohio; 16 miles, 20-in., planned, Benton Station to Crawford Station; 18 miles, 20-in., Crawford Station to near Columbus; 16 miles, 16-in., planned, Berlin to Sandusky, Ohio.

74 miles, 3 to 20-in., planned, Hocking, Knox, and Ashland counties, Ohio.

47 miles, 20-in., planned, Benton Township, Hocking County, to Columbus, Ohio.

61 miles, planned, northern and southwestern Ohio.

33 miles, 20-in., proposed, Jefferson to Seneca, Ohio.

69 miles, 20-24-in., proposed, lines to tiein Gulf Interstate line along various points in Lawrence, Jackson, Vinton, Hocking and Fairfield counties, Ohio.

• **Pacific Gas & Electric Co.**—50 miles, 12-16-20-in., planned, Fresno to Merced, Calif.

(Section 2) 20-in., Holm to Topock-Milpitas line.

(Section 3) 12-in., parallel existing Madera Livingston line, planned. Napa Wye to Shellville; Cotati to Santa Rosa, Calif.

129 miles, 31-in, proposed, main-line loops along Topock, Ariz., to Milpitas, Calif. Completion date 11-54.

Pacific Gas & Electric Co.—88 miles, 34-in., under way, portions of 34-in. Topock-Milpitas pipe line. Completion date 4-15-54.

• **Pacific Northwest Pipeline Corp.**—1,466 miles, proposed, Ignacio, Colo., to Bellingham, Wash.

380 miles, proposed, laterals and spurs off

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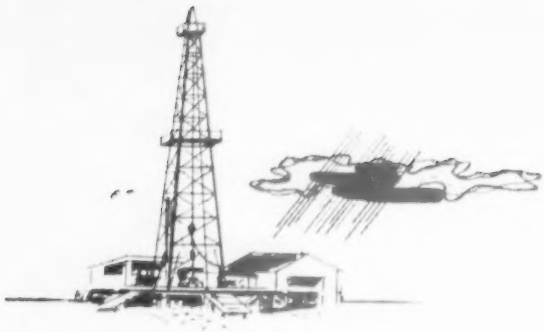

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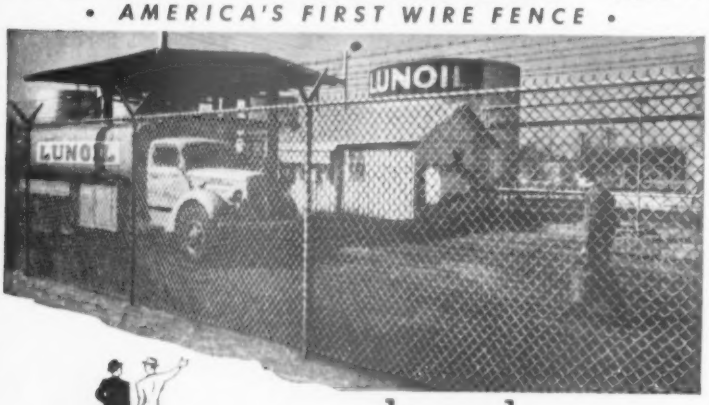

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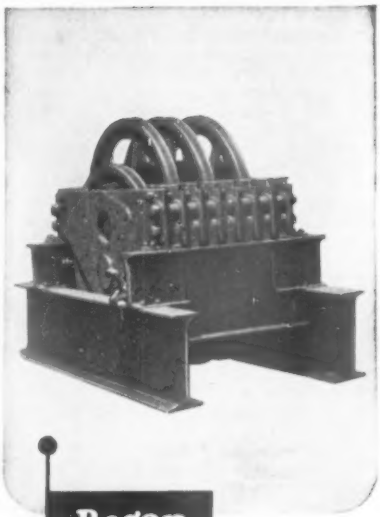

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main line to Pocatello, Idaho, to Yakima, Wash.

Permian Basin Pipeline Co.—280 miles, 16-24-26-30-in., under way, West Texas and New Mexico. R. H. Fulton & Co.

• **Rockland Light & Power Co.**—22 miles, 8-in., proposed, Orangetown to Tompkins Cove, N. Y.

• **Shenandoah Gas Co.**—39 miles, 3-4-8-in., proposed, Middleton, Va., to Martinsburg, W. Va.

South Carolina Gas & Electric Co.—160 miles, 16-12-10-in., contracted, Aiken, S. C., to cities of Columbia, Summerville, and Charleston, S. C. Williams Bros. Completion date 1-54.

• **South Georgia Natural Gas Co.**—339 miles, 2-12-in., planned, Phoenix, Alta., to Tallahassee, Fla. (a) 12-in., Phoenix, Ala., to Albany, Ga., (b) 10-in., Albany, Ga., to Moultrie, Ga., (c) 8-in., Moultrie, Ga., to Tallahassee.

Southern California Gas Co., and Southern Counties Gas Co.—73 miles, 30-in., under way, loops on main line from Blythe to Los Angeles. River Const. Co. 1-54.

Southern Natural Gas Co.—1,235 miles, 24 to 4½-in., under way, Louisiana, Mississippi, Alabama, and Georgia, and South Carolina. Houston Contracting, Latex and H. C. Price. Fall 1953.

Elmore, Ala., to Tallahassee, Ala. Houston Contr. Completion date 12-1-53.

Gwinville to Pickens. Completion in 1954.

Gwinville, Miss., to Ellerslie, Ga. Completion in 1954.

Sanderville, Ga., lateral. Completion date 12-1-53.

• **Southwest Gas Corp., Ltd.**—26 miles, proposed, from P.G.&E. line to Victorville, Calif.

Tennessee Gas Transmission Co.—571 miles, 30-in., planned, Kinder, La., to Portland, Tenn.

67 miles, 30-in., planned, loops in Texas and Louisiana.

63 miles, 26-in., planned, loops in Ohio and Pennsylvania.

58 miles, 20-in., planned, Louisiana Gulf Coast to Station No. 507 near Kinder, La.

100 miles, laterals in Texas.

45 miles, 20-in., proposed, Buffalo, N. Y., to the U. S.-Canadian border Hamburg station near St. Catherines.

• **Texas-Ohio Gas Co.**—1,435 miles, 30-in., proposed, Hidalgo County, Texas, through Arkansas, Mississippi, Tennessee, and Kentucky on to Spencer, W. Va.

• **Trans-Northwest Gas, Inc.**—246 miles, proposed, International Boundary near Osoyoos, B. C., to Washington and Idaho.

275 miles, branch lines.

• **United Gas Fuel Co., and Central Kentucky Natural Gas Co.**—92 miles proposed, Gulf Interstate system, Boyd County, Ky., to Putnam County, West Virginia.

• **United Fuel Gas Co.**—50 miles, 20-24-in., proposed, Wood County to Lanham, W. Va. Spring 1954.

32 miles, 24-in., proposed, near Ripley, W. Va., to Lanham station, Putnam County, W. Va.

60 miles, 30-in., proposed, Lanham in Kanawha County, West Virginia, to Gulf Interstate line in Boyd County, Ky.

United Gas Pipe Line Co.—44 miles, 20-in., under way, Lirette field to Harvey, La. Brown & Root.

• **United Natural Gas Co.**—50 miles, 12-in., planned, Elk County to Jefferson County, Pennsylvania.

• **Utah Natural Gas Co.**—103 miles, 16-18-in., proposed, Clear Creek field near Price to Salt Lake City, Utah.

18-in., Clear Creek to Provo, Utah.

16-in., Provo to Salt Lake City, Utah.

Virginia Natural Gas Co.—153 miles, Buckingham to Richmond and Portsmouth, Va.

Warren Petroleum Co.—54 miles, 4-30-in., planned, Lea County, New Mexico.

25 miles, 3 to 20-in., Garvin County, Oklahoma. Completion date 6-54.

Westcoast Transmission Co., Ltd. — (See foreign natural gas pipe lines).

Foreign Crude-Oil Pipe Lines

• **Arabian American Oil Co.**—18 miles, 22-20-in., planned, Qatif to Ras Tanura No. 3. Completion date 1-55.

Bombay Port Trust.—50 miles, 8 to 24-in., contracted, Bombay, India, to serve Standard Vacuum Oil Co., and Burmah Shell refineries. Merritt, Chapman & Scott Corp., contractors. (Crude and Products.)

• **Creole Petroleum Corp.**—25 miles, 34-in., planned, Lagunillas to La Salina (State of Zulia, Venezuela.)

Direccion General de Yacimientos Petroliferos Fiscales—409 miles, under way, Plaza Huincul to Bahia Blanca, Argentina.

• **Gaz de France**—200 miles, 12-in. Ruhr to Paris, France.

• **Petroleos Mexicanos.**—145 miles, 12-in., considered, 18 de Marzo field via Reynosa to Monterrey, Mexico.

100 miles, planned, Isthmus of Tehuantepec, Jose Colomo to El Plan field, Minatitlan.

72 miles, 12-in., proposed, Poza Rica to Atzacapotzalco, Mexico.

Petroleos Mexicanos.—125 miles, 10-in., under way, Jose Colomo to El Plan, Mexico.

• **Saskatoon Pipe Line, Ltd.**—56 miles, 6-in., planned, Milden to Saskatoon, Sask.

Texas Petroleum Co.—60 miles, 4-6-in., under way, Pta. Nino to La Dorada.

• **Trans Mountain Oil Pipe Line Co.**—30 miles, planned, Vancouver, B. C., terminal to Ferndale, Wash.

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THE TOLEDO PIPE THREADING MACHINE CO.,
Toledo, Ohio

anos.—170 miles, 4-in., planned, Bermejo to Tupiza, Bolivia.

Foreign Products Pipe Lines

Anglo-Iranian Oil Co., Ltd.—18½ miles, 16-in., under way, Little Aden to Aden. Bechtel Corp. Completion date December 1954.

18½ miles, 6-in., under way, Little Aden to Aden. Bechtel Corp. Completion date December 1954.

15 miles, 12-in., under way, Kwinana to Fremantle. M. W. Kellogg Co. Completion date February 1955.

17 miles, 6-in., Kwinana to Fremantle. M. W. Kellog Co. Completion date February 1955.

Columbian Ministry of Petroleum—115 miles, 4-in., under way, La Dorado to Cartago, Colombia, Williams Bros. Engineers.

93 miles, 8-in., under way, Cantimplora to Dorado, Colombia, William Bros. Constructors.

• **Empresa Nacional del Petroleo** — 80 miles, 6⅝-in., planned, Concon to Santiago, Chile.

• **Governments of Southern Rhodesia and Portuguese East Africa.**—200 miles, considered, Beria, Portuguese Mozambique to Umtalia, Southern Rhodesia.

North Atlantic Treaty Organization (NATO)—1,920 miles, 4-10-in., to serve military bases in Western Europe (to connect with U. S. Government's St. Nazaire-Paris-Metz line.) Contracted by Soc. Foster Wheeler Francaise.

• **Petroleos Mexicanos.**—124 miles, 6-in., planned, Lagos to Guadalajara, Mexico.

54 miles, 6-in., planned, Lagos to Aguascalientes, Mexico.

82 miles, 8-in., planned, Salamanca to Lagos, Mexico.

Shell Co. of Australia.—34 miles, 8-in., under way, Geelong, Melbourne Ref. to connect with installations at Newport, Australia, Taylor Woodrow. 11-53.

• **United States Government.**—375 miles, 12-in., planned, St. Nazaire to Melun and Metz, France.

• **United States and Canadian Governments**—600 miles, 8-in., planned, Haines to Fairbanks, Alaska.

Foreign Natural-Gas Pipe Lines

Azienda Generale Italiana Petroli.—110 miles, 12-14-16-in., under way, Cortemaggiore to Genoa. Completion date 11-53.

Azienda Generale Italiana Petroli — 90 miles, 12-in., under way, Cortemaggiore to Bologna, Italy, SNAM crews.

120 miles, 16-in., under way, Cremona Porto Mar to Ghera, Italy, Montubi, contractor.

40 miles, 12-in., under way, Ripalta-Bergamo, Italy.

Dirrecion General del Gas del Estado—310 miles, 8-in., under way, Plaza Huincul to Neuquen, Argentina, to the vicinity of General Conesa, Argentina.

• **Empresa Nacional del Petroleo** — 80 miles, 10-in., planned, Concon to Santiago, Chile.

• **Mid-Continent Pipelines, Ltd.** — 1,860 miles, 30-in., proposed, Alberta to Montreal Canada. Fish Engineering Co.

• **Northwest Natural Gas Co.**—950 miles, 24-in., planned, Alberta fields to Vancouver, B. C., Seattle, Wash., and Portland, Ore.

Petroleos Mexicanos. — 205 miles, 16-in., under way, Monterrey to Torreon, Mexico.

• **Petroleos Mexicanos.**—440 miles, 20-in., planned, Brazil to Tampico to Poza Rica Mexico.

• **Trans-Canada Pipe Lines, Ltd. (Canadian Delhi Oil Co.)**—2,247 miles, 14 to 30-in., proposed, Alberta to Toronto to Montreal.

747 miles, 8 to 24-in., gathering system in Alberta.

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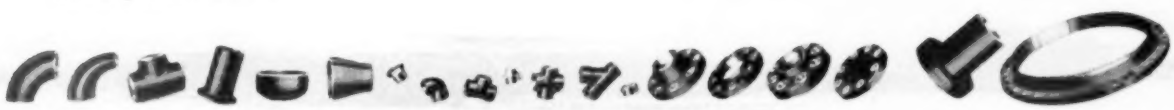

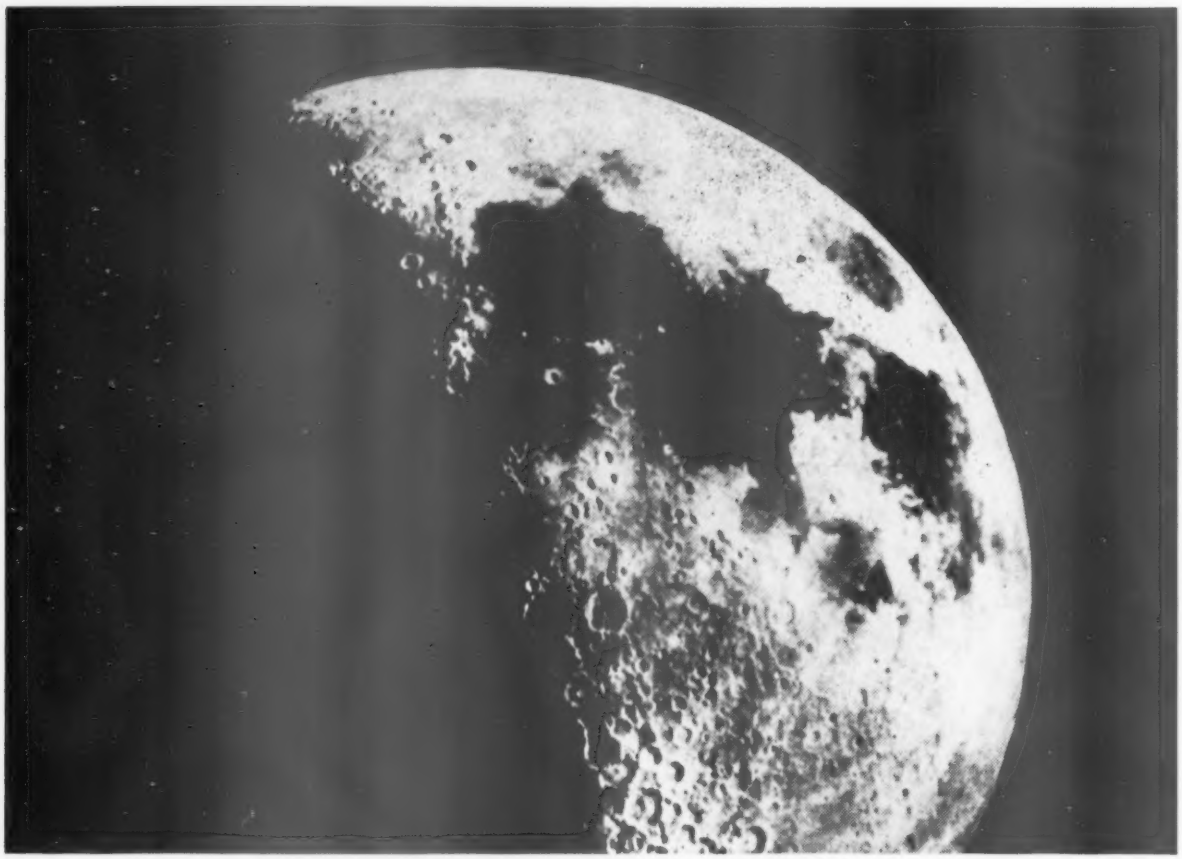

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At this time, during the annual meeting of the American Petroleum Institute in Chicago, Skelly Oil Company salutes this champion of progress in petroleum. As in years gone by, we pledge our cooperation with the objectives and ideals of the American Petroleum Institute.

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PIPE LINE

Tie-In Lines With Southern Natural Gas System Planned

WASHINGTON.—The Federal Power Commission will open a hearing here this week on proposed construction of over 80 miles of gas lines connecting Southern Natural Gas Co.'s transmission system in Alabama, Georgia, and Mississippi.

Those making the proposals are Northwest Alabama Gas District, Villa Rica, Ga., Dekalb, Miss., and Mississippi Valley Gas Co.

Northwest Alabama proposes to lay 40.3 miles of 9⅝-in. line from Southern Natural's system near Birmingham to Winfield, Ala. From this latter point a 26-mile, 7⅝-in. line is planned to Haleyville, Ala., with lateral lines connecting Fayette, Guin, Hackleburg, Hamilton, Sulligent, Bear Creek, and Boston, Ala. The entire project will cost about $4,100,000.

The application by Villa Rica, Ga., covers a proposed 6.5 mile, 6⅝-in. line from Southern Natural's system near Macon to the Villa Rica city limit, and a distribution system within the community and adjacent Fullerville, Ga. Estimated cost of the facilities is $515,000.

Dekalb, Miss., plans to construct a 10-mile, 3-in. line from Southern Natural's system in Kemper County, Mississippi, to the town's limits. Also, a distribution system within the town and surrounding areas is planned. After the $200,000 project is completed, Mississippi Valley Gas proposed to take over and operate the facilities.

Coal Group Seeks Additional Limitations on Gas Lines

WASHINGTON. — The National Coal Association has adopted a resolution calling upon the Federal Power Commission and Congress to impose more binding restrictions on natural-gas firms and transmission companies in order to conserve gas supplies.

Part of the resolution urges the FPC "to refuse to issue certificates of convenience and necessity for natural-gas pipe lines where the natural gas to be transported by such a pipe line, or any substantial portion thereof, will be used as boiler fuel or will be used for inferior purposes for which adequate supplies of bituminous coal are available."

This is a followup by a request to Congress "to adopt a national fuel policy with respect to the conservation of

Miles of Line Pushed Into Ditch

Virtually all of United Gas Pipe Line Co.'s new 43-mile, 20-in. gas line from Lirette to Harvey, La., lies in watery swamp lands. Here sidebooms give a 9,300-ft. section of the gas line a shove through southern Louisiana sugar cane fields. (H. C. Price Co. photo.).

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natural gas which would have the effect of prohibiting the use of this valuable resource for inferior purposes for which adequate supplies of bituminous coal are available."

In addition, the resolution appeals to both the FPC and Congress to follow a course of action which would allow natural-gas companies to get a fair field price for their own produced gas, and independent producers "a fair commodity value" for gas sold to pipe-line companies.

Part of Interstate's New Crude System on Stream

SHREVEPORT.—Interstate Oil Pipe Line Co. has placed in operation about half of its new 136-mile, 22-in. crude line between here and Baton Rouge.

The remainder of the line will go on stream soon when the company's Finney pump station near Shreveport is completed. The new line increases the capacity of the firm's Shreveport-Baton Rouge system from 102,000 bbl. to 365,000 bbl. daily *(The Oil and Gas Journal, August 3, page 119)*.

In addition, company officials announced that a new 60-mile, 16-in. connection with southern Louisiana fields is now operating.

FPC to Hear Applications For Alabama Gas Lines

WASHINGTON.—A group of applications involving construction of a network of proposed natural-gas lines in northeast Alabama will be heard by the Federal Power Commission here this week.

The applications were submitted by Alabama-Tennessee Natural Gas Co., Florence, Ala.; Tennessee Gas Transmission Co., Houston; Waterworks and Gas Board of Cherokee, Ala.; Russellville, Ala.; and the Lawrence-Colbert, Ala., Gas District.

Alabama-Tennessee plans to increase gas deliveries to existing customers by constructing nearly 13.2 miles of 12 and 8-in. loops and a 350-hp. compressor station in Colbert County. Tennessee Gas is seeking FPC authority to supply the Alabama firm with the extra 8.5 million cubic feet of gas daily.

The remaining three applicants are seeking part of the increased deliveries. However, Alabama-Tennessee asserts that the additional gas is not adequate to supply new customers.

The Cherokee Waterworks and Gas Board proposes to construct necessary pipe-line facilities which would handle up to 243,000 cu. ft. of gas daily. Cost of these facilities has been set at $105,000.

Also, Russellville plans to tie in with

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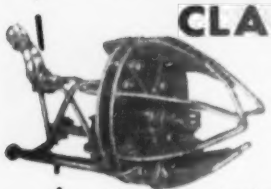

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Alabama-Tennessee system with 16.5 miles of line which will cost about $930,000. The proposed system would enable the town to receive up to 1,846,000 cu. ft. per day.

The Lawrence-Colbert Counties Gas District is seeking to supply the communities of Moulton, Courtland, Leighton, and Town Creek, Ala., with natural gas through a new distribution system now under construction. Alabama-Tennessee claims it is presently delivering gas to the three latter towns.

Nevada Gets Financing For 114-Mile Gas Line

LAS VEGAS.—By placing $1,150,000 of 5 per cent first mortgage bonds due in 1973 with Mutual Life Insurance Co. of New York, Nevada Natural Gas Pipe Line Co. has overcome its last obstacle in completing a 114-mile gas line from Topock, Ariz., to a point near here.

Proceeds from the bonds will cover about half of the construction expense for the line, which is nearly 50 per cent finished. The line will be completed late in December. It will extend from a connection with El Paso Natural Gas Co.'s system at Topock, Ariz., northward into Clark County, Nevada, supplying areas along the route in addition to Las Vegas.

One of the first major problems the company faced was determining what size pipe should be used. In June 1952 the Federal Power Commission approved the project which then called for 10¾-in. pipe. Later company officials felt that 12¾-in. pipe would serve their purpose better and had the FPC amend the order. However, further study revealed that 10¾-in. pipe would provide adequate gas supplies, and the company returned to the FPC this fall seeking the original order *(The Oil and Gas Journal, October 12, page 187)*.

Buckeye Buys Crude Lines

NEW YORK.—Buckeye Pipe Line Co. here has purchased Transit & Storage Co.'s crude-line properties in Ohio and Michigan.

Transit, a subsidiary of Imperial Oil, Ltd., operated 454 miles of 6 and 8-in. lines between Cygnet, Ohio, and Sarnia, Ontario. The lines supplied United States crude to Imperial Oil's Sarnia refinery, which is now switching to Alberta crude. The crude will be supplied through Lakehead Pipe Line Co.'s system which is being extended from Superior, Wis., to Sarnia. Final weld on this new extension was made November 3. *(See news section.)*

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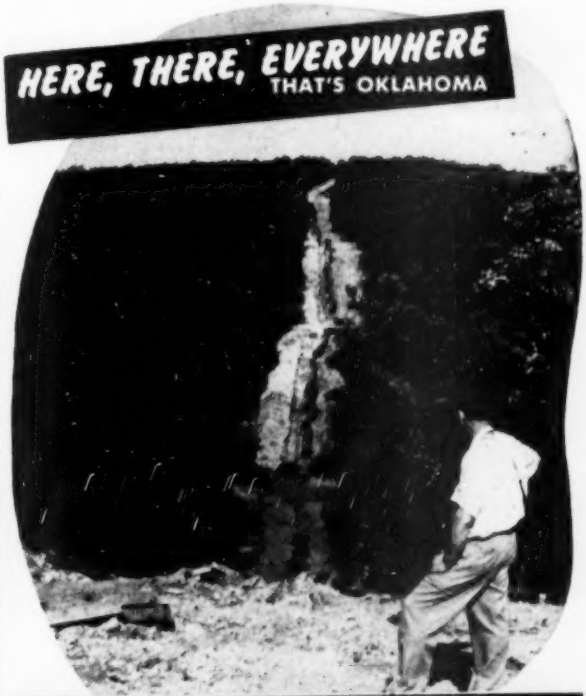

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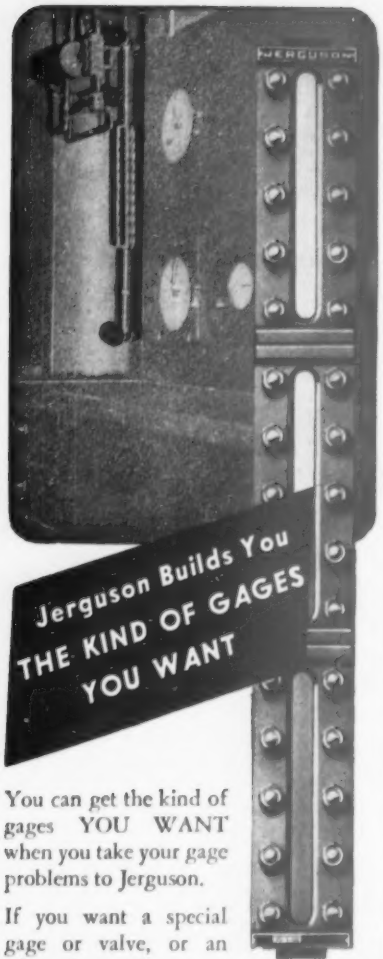

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REFINING

McBride to Reorganize, Expand Brownsville Plant

SAN ANTONIO.—H. L. McBride, president of McBride Refining Co. and of Port Fuel Co., has announced plans here for a $5,000,000 program of refinery expansion, reorganization, and oil and gas development.

Plans call for a $2,500,000 expansion of facilities at Port Fuel's Brownsville, Tex., refinery. This will increase the refinery's capacity from 7,500 to 20,000 bbl. daily. McBride said that the refinery "will have the latest and finest catalytic reforming process."

The remainder of the money will go into intensive exploration and development of McBride's properties, and consolidation of all the company's interests under the firm name McBride Oil & Gas Corp. Financing for the entire project will be handled through a stock issue.

Lion Finishing Expansion

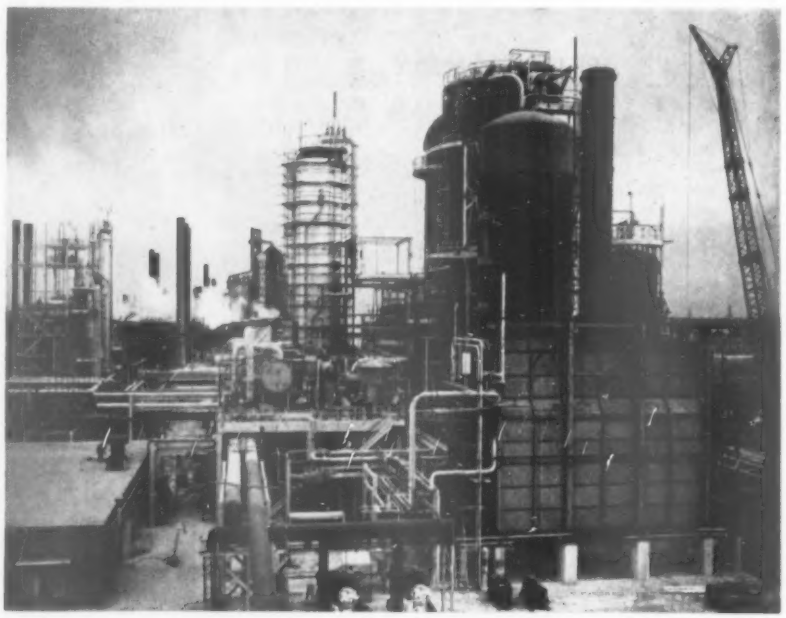
EL DORADO.—Lion Oil Co.'s $5,000,000 expansion program will be climaxed within 2 weeks when several new units at its 22,000-bbl. refinery will go on stream.

The new facilities include a catalytic cracker, alkylation unit, vapor-recovery plant, and various auxiliary units. Work on the project, which will give the refinery an added 1,500 bbl. in crude-charging capacity, began last summer *(The Oil and Gas Journal, August 31, page 159)*.

Refining Briefs

WILMINGTON, Del.—A new gasoline-soluble dye, Du Pont Oil Bronze, has been developed by the Petroleum Chemicals Division of E. I. du Pont de Nemours & Co., Inc., here. Company officials claim the new dye will produce a red-orange or bronze shade simplifying operations for refiners who have been using several dyes to obtain this shade.

TOLEDO.—Gulf Refining Co. has been awarded a certificate of necessity permitting accelerated amortization on a 10,000-bbl. per day Platforming unit for the 40,000-bbl. per day refinery here. The cost of the unit is placed at $4,878,687, of which 65 per cent will be amortized over a short period. Auxiliary facilities for high-octane gasoline manufacture will cost $797,466.



Pan Am's Texas City Refinery Gets Second Cracker

This new catalytic cracking and polymerization unit was placed on stream recently at Pan American Refining Corp.'s Texas City, Tex., refinery. The unit processes up to 30,000 bbl. daily of gas-oil to produce more than 9,000 bbl. of high-octane blending stock. Cracker is at center, its integral poly unit at the right.

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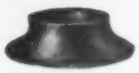

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Big Output Seen

Excess benzene capacity predicted for next year

WASHINGTON. — A projected production of 8,928,571 bbl. of benzene per year by 1955 was estimated recently by L. A. Schleuter of the American Coke and Chemical Institute here.

Speaking before the institute's annual meeting, he stated that by that time some excess capacity for the important aromatic basic may exist due to the need to expand capacity to meet the preparedness goal set by the National Production Authority.

Benzene requirements for 1954 will about equal those for the current year, he said, with a cutback in the consumption of styrene for synthetic rubber offsetting the probable increase in styrene demand for plastics and other uses. Since 60 per cent of benzene production goes into the styrene and phenol used in plastics, Schleuter pointed out it is obvious that developments in plastics affect benzene demand to an important degree.

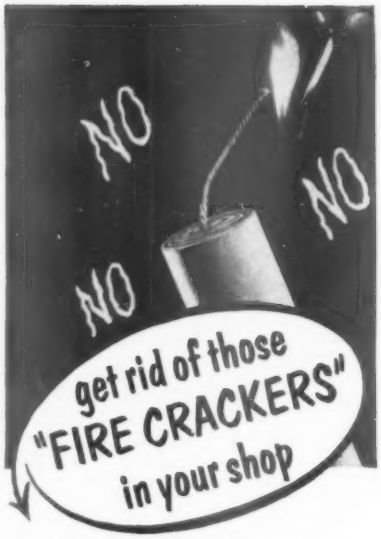
Stabilized prices . . . He looks for no benzene price war to develop between the petroleum and coke-oven industries, since the growing demand for high-octane gasoline will tend to divert petroleum aromatics to gasoline blending. Toluene, currently in fairly tight supply, should ease, se said, with new productive capacity coming in at the end of the year. Over 70 per cent of toluene is now going into TNT and avgas.

In contrast to the pessimistic outlook for toluene, Schleuter sees the xylene isomers as important chemical building blocks in the future. Mixed xylenes, byproducts of paraxylene production for synthetic fibers, are already competing with toluene in the solvents field. The metaxylene fraction from this byproduct stream shows possibilities of use for synthesis of isophthalic acid which can complete with phthalic anhydride.

Monsanto Lets Contract for Texas Polyethylene Plant

TEXAS CITY, Tex. — Monsanto Chemical Co. has let contract for construction of its first polyethylene plant to Farnsworth & Chambers, Houston.

The plant, on which preliminary construction work already has started, will be situated adjacent to Monsanto's existing units here and is expected to be in operation by the fourth quarter of 1954. Initial daily capacity will be over 180,820 lb.



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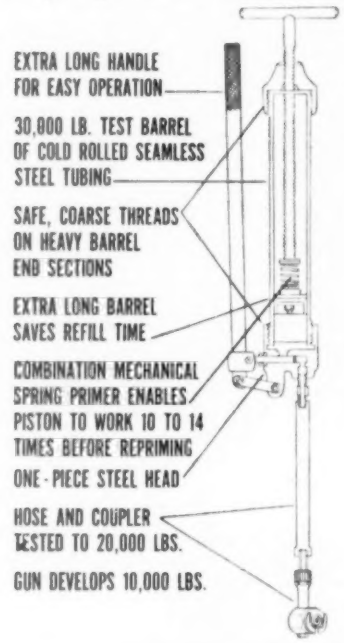
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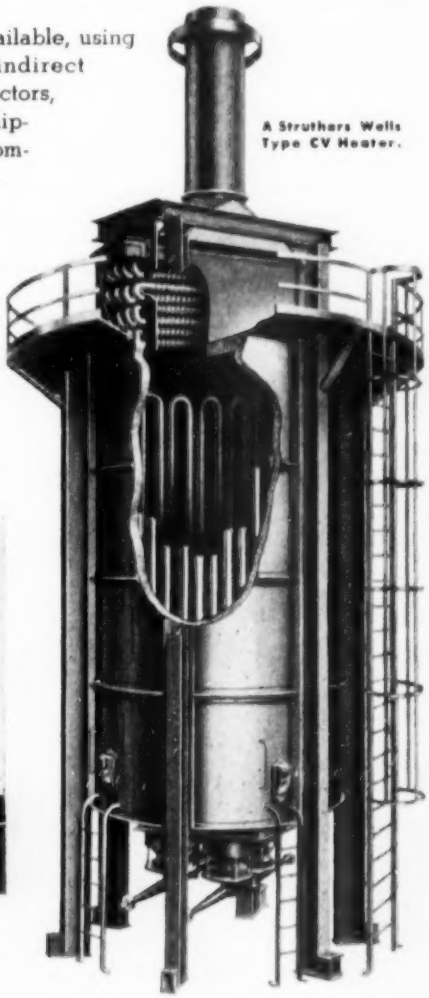
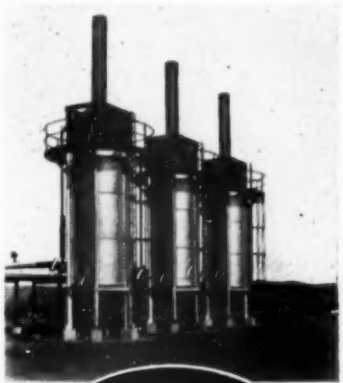


A Struthers Wells Type CV Heater.



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NATURAL GAS

Storage Headache

Peoples still plagued by leaks in Herscher project

CHICAGO. — Approximately 10 billion cubic feet of gas has been stored in Peoples Gas Light & Heat Co.'s huge underground-storage project at Herscher, Ill., despite seepage in certain old water wells and abandoned oil wells in the area.

Max W. Ball, Washington, D. C., gas consultant, told company officials that the seepage is not the fault of the reservoir itself but is the result of gas leaking through or behind well casings. Tests have shown that there is no gas in any formation below the storage zone. Ball assured the company that the situation would be remedied in due time.

Old problem . . . Seepage forced the firm to discontinue injections last August until the trouble was found in one of the project's 21 injection wells. After the leak was stopped, the seepage virtually ceased and injection operations were resumed *(The Oil and Gas Journal, September 24, page 173).*

Despite these setbacks, company officials still anticipate storing 20 billion cubic feet of gas in the reservoir by the end of December. Ultimately, the storage capacity of the project is expected to reach 90 billion cubic feet *(The Oil and Gas Journal, August 24, page 175).*

Peoples Gas expects to spend $50,000,000 on the storage project, which will be the nation's largest. To date, the project has cost about $14,500,000.

Tennessee Gas Seeks Tax Refund in Federal Suit

HOUSTON.—A suit has been filed against the United States Government by Tennessee Gas Transmission Co., Houston, for $740,308 the company allegedly over paid in 1948-49 taxes.

In effect, the suit asks the federal District Court to extricate the company from a tangle of red tape produced by conflicting rulings from two federal agencies. The petition states that the Bureau of Internal Revenue ruled that the amount was taxable income, but the Federal Power Commission held last month that it should be treated on company books as a plant-account reduction.

R. L. McVey, vice president, stated recently that the court suit would be the only way Tennessee Gas could determine how the transaction could be recorded.

"It is a case," McVey said, "of Uncle Sam's right hand not knowing what his left hand does, or rather of not caring."

The company claims the overpayment was based on $2,000,000 which it received in adjustments for transfers of steel pipe and steel plate in the years involved, but that this money was not income. It claims the money came as a result of transfers involving 10 other firms and that it represented, rather than income, a saving in the cost of pipe-line construction.

P. G. & E. Uses TV to Change Steam Plant's Furnace Fuels

MOSS LANDING, Calif. — Television is being used to regulate fuel changes in furnaces at Pacific Gas & Electric Co.'s steam plant on Monterey Bay here.

Operating on a closed circuit, the TV permits powerhouse operators to interchange natural gas and oil as fuel for the eight boiler furnaces. Television cameras are set against a window in the wall of the boiler and are protected from the intense heat by a high-pressure blast of cold air across the window. These cameras enable workers in a control room in another part of the plant to look into the furnaces and check the changeover of fuels.

Under the old system of interchanging fuels, individuals were stationed at the furnaces to check the 12 burners in each unit. This process consumed 25 minutes or more. Now with television the entire operation can be carried out by one man within 6 minutes.

The switching from natural gas to oil and vice versa, occurs several times each day. This is brought about when customer demands for gas require P. G. & E. to retain all the gas in its transmission system and cut off the plant's supply.

Deliveries Boost Planned

WASHINGTON.—The Federal Power Commission opened a hearing here last week on Texas Gas Transmission Corp.'s application to increase gas deliveries to Linton, Ind., and Terre Haute (Ind.) Gas Corp.

Previously Texas Gas had been authorized to deliver 9,560,000 cu. ft. of gas daily to Terre Haute, and 2,050,000 cu. ft. per day to Linton. The company now plans to transport 12,475,000 cu. ft. daily to Terre Haute and 2,700,000 cu. ft. per day to Linton. The additional gas would be delivered through existing facilities.

Opposing the proposal is the Memphis Light, Gas & Water Division.

August Production Drops

AUSTIN.—August gas production in Texas dropped 395,130 M.c.f. compared to the state's output the previous month, according to the Texas Railroad Commission.

The latest production figures totaled 424,949,071 M.c.f. and in July 435,344,201 M.c.f. was reported produced. As usual, transmission lines used the bulk of the monthly production. This outlet claimed 279,438,074 M.c.f. of the August output. Of this amount 178,955,541 M.c.f. was exported.

The remainder of the month's gas was used as follows: cycled, 42,277,973 M.c.f.; plant fuel and lease use, 34,155,079 M.c.f.; pressure maintenance and repressuring, 25,345,473 M.c.f.; vented, 21,550,598 M.c.f.; extraction loss-plants, 16,399,388 M.c.f.; carbon black, 15,747,978 M.c.f.; and plant meter difference, 34,508 M.c.f.

Emergency Supply Approved

WASHINGTON.—Cities Service Gas Co., Oklahoma City, and Natural Gas Pipe Line Co. of America, Chicago, have received Federal Power Commission permission to supply each other with necessary gas supplies during periods of emergency.

The deliveries will be made through an existing connection between the two firm's systems in Ford County, Kansas. This 8-in. connection was constructed in July 1952 when the FPC authorized Cities Service to supply Natural Gas with 16,500,000 cu. ft. of gas daily through the following September.

Natural Gasoline

Texaco Plans L.P.G. Project

AUSTIN.—The Texas Co. is seeking Texas Railroad Commission authority to store up to 100,000 bbl. of L.P.G. under the company's P. L. Fuller lease on the H. & T. C. Survey, Scurry County, Texas.

The firm plans to leach out the salt section from 550 to 1,200 ft. in the Whitehorse group of upper Permian. Brine will be deposited in a porous formation which contains no oil or gas.

stop vibration before it starts

A Fluor Pulsation Dampening Piping System smooths out the "puffs" created by reciprocating action of compressors. It eliminates one of the chief causes of piping vibrations. A smooth, steady gas flow incurs less frictional resistance and reduces line breakage due to pipe fatigue. Without dampeners there is no alternate solution: *no matter how well pipe is anchored, the basic pulsations remain* – to cause problems with metering accuracy and plant safety.

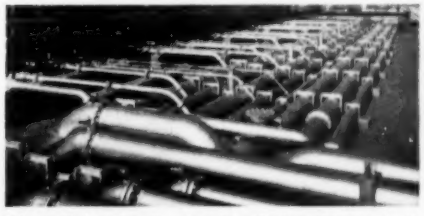
with a FLUOR pulsation dampening piping system

For new construction, Fluor supplies the complete piping system, prefabricated, ready for installation. Pulsation dampening is designed right into the basic compressor system through an engineered selection of bottles, headers and laterals. *It is built in, not added on.* And it costs little more than a conventional system because it eliminates expensive pipe anchoring and allows the design of related equipment based on a system free of pulsative flow.

For existing construction, Fluor's two "package-type" Pulsation Dampeners, in both manifold and in-line types, are easily installed in existing plants with an excessive vibration problem. The Fundamental Dampener minimizes objectionable pulsations while providing the continuous advantages of low pressure drop and less stress on piping, heat exchangers and vessels. The High Frequency Dampeners are supplied where pulse frequencies are in the range of the second harmonic or higher.

Fluor's Mobile Research Laboratory

Manned by capable engineers experienced in the phenomena of sound and vibration, Fluor's Mobile Research Lab is fully equipped to conduct on-the-spot tests to determine the source, extent and best means of eradicating plant piping vibration.



Fluor Pulsation Dampening Piping System built into new compressor station assures accurate metering.

Fluor Pulsation Dampeners curb vibration caused by reciprocating action of compressors.

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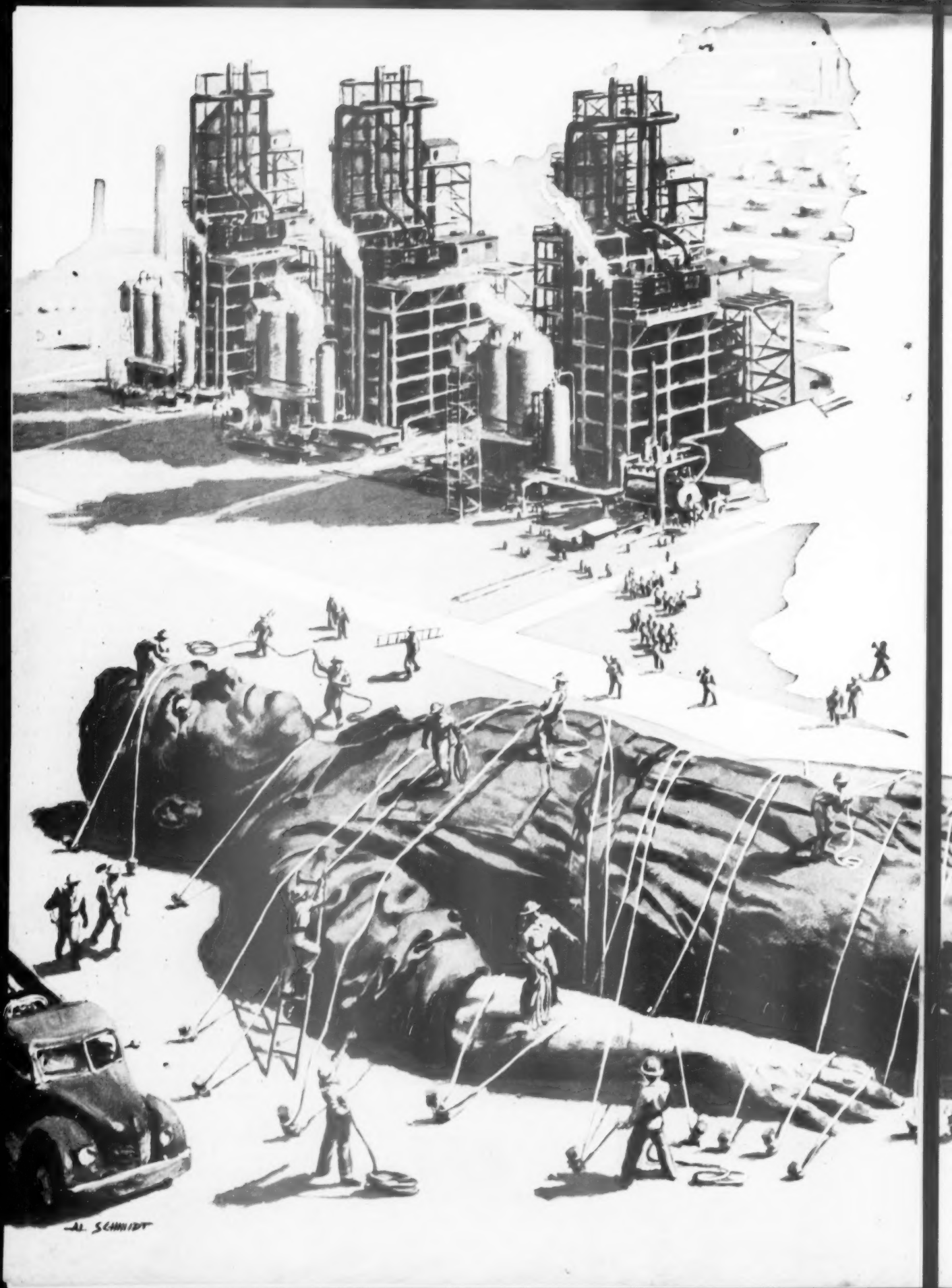
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How Would You Go About Taming a Giant?

FOR MILLIONS OF YEARS the Giant slept.

In 1863, Man disturbed his mighty slumber, tamed him and put him to work for the good of all.

The Giant was called Petroleum.

How did enterprising men go about harnessing this stupendous new source of energy?

Here is how they did *not* go about it:

They did *not* turn the problem over to a government agency.

They did *not* say, "Whale oil is good enough. Why bother with this newfangled stuff?"

They did *not* say, "Too many problems involved. Too many risks. We might lose our shirts."

They *did* get to work and promote risk capital for drilling.

They *did* make this new source of energy available to all the people.

They *did* seek—and find—new ways to put the Giant's talents to work making hundreds of new products, creating thousands of new jobs.

Among these energetic giant-tamers were men of Cities Service. They had begun as processors of whale oil. They were quick to see the possibilities of "rock oil." They were among the first to study the sciences of combustion and petro-chemistry.

The petroleum Giant is now a docile servant of mankind. It has made our lives easier in countless ways. But Cities Service researchers say it has muscles it hasn't even used yet!

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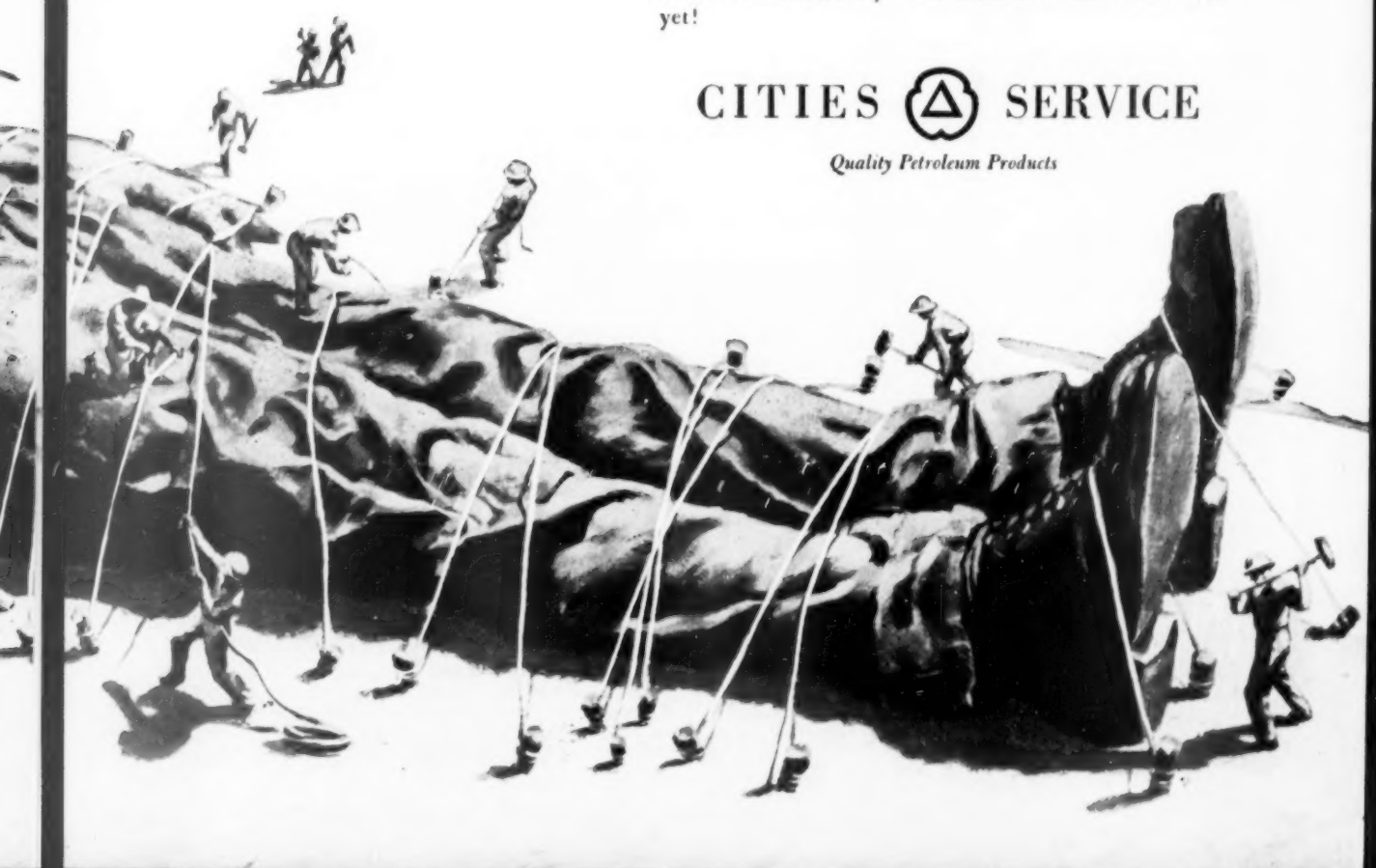

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Among the Drilling Contractors

Drilling Spurt Boosts Number of Active Rigs

Drilling activity in the United States and western Canada took another spurt during the week ended November 9, boosting the number of operating rotary rigs to 2,925, an increase of 48 over the previous week. The total, however, was 5 short of the year's "high" of 2,930 rigs reported running a month ago, but was 119 above the number operating the corresponding week last year.

All areas, except the Gulf Coast and Pacific Coast, reported increases in activity during the week. In the Rocky Mountain region, the number of active rigs climbed to 303, a new all-time record and the first time it has been above 300. Activity in the Arkansas-North Louisiana-East Texas area was the greatest it has been any time this year.

ACTIVE ROTARY RIGS*

Area—	Week ended 11-9-53	Change week ended 11-2-53	Change week ended 11-10-52
Gulf Coast	585	—14	— 13
N. & W. Tex.-N. M.	839	+19	— 2
Ark.-N. La.-E. Tex.	195	+ 5	+ 52
Oklahoma	364	+17	+ 45
Kansas-S. Nebraska	164	+ 4	— 11
Illinois-Eastern	163	+16	+ 17
Rocky Mountains	303	+ 6	+ 67
Pacific Coast	161	0	— 8
Total U. S.	2,774	+53	+147
Western Canada	151	— 5	— 28
Total	2,925	+48	+119

*Courtesy Hughes Tool Co. Trends in drilling activity in the United States, North and West Texas-New Mexico, and Oklahoma-Kansas are shown on pages 450 and 451.

Longhorn Drilling Corp., San Antonio and Three Rivers, Tex., has the contract to drill a 10,000-ft. well for Western Natural Gas Co., of Houston, at 1 D. O. States Unit, in the La Blanca gas area, east of Edinburg, Hidalgo County, in the Rio Grande Valley, South Texas. Longhorn also is contractor on a 6,000-ft. well Shell Oil Co. is drilling at 1-R Serna, in the Seven Sisters field, in Duval County, South Texas.

Archie C. Myers, Bakersfield, Calif., has contracted for a 1,500-ft. test to be drilled for Loren L. Hillman, Long Beach independent operator, at a wildcat location 1½ miles west of Kern County field, in Kern County, California. Location is for 1 Roos, in 11-29s-28e.

Field Drilling Co., contractor on Great Lakes Carbon Co.'s recently completed discovery well in the Lasso area, in Jackson County, South Texas, is starting a confirmation test for the same company. The second test, 1 Babb, is located 1,900 ft. southwest of the discovery well, completed as an oil

William F. Symons (third from right), principal owner of Symons Drilling Co., Houston, with his tool pusher, Joe G. Blasdel (fourth from right), and drilling crew on a rig this company is operating under contract for J. S. Abercrombie Co., of Houston, in Old Ocean field, Brazoria County, Texas Gulf Coast. Crewmen, left to right, are: L. V. Young, J. E. Westbrook, G. D. Morlan (driller), and J. W. Doggett. (Photograph by courtesy of Mission Manufacturing Co., Houston.)

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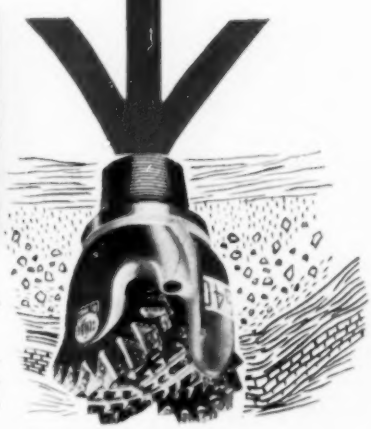
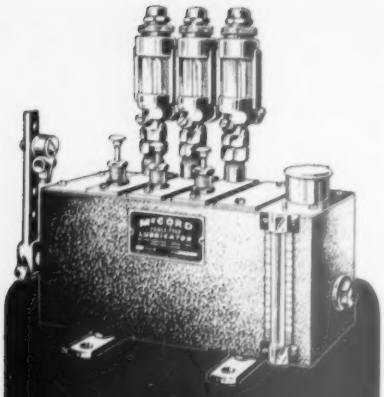


GLOBE "4-CUTTER" INTEGRAL JET ROCK BIT



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The improved McCord Tubular "Clearsite" Feed is the latest development in lubricator visible sight feeds. Less susceptible to clouding, it carries a greater supply of liquid and may be cleaned without removing it from the pump or disconnecting it from the oil line. The McCord "SF" Lubricator provides close and accurate feed adjustments with a degree of reliability that has made this the preferred lubricator in the oil field. The advantages of easy removal of pump units, welded steel tanks, the wide variety of drives, and the new type graduated oil level gauge which provides clearer visibility are McCord features that make the "SF" Lubricator outstanding. Lubricators are in stock and deliveries are prompt.

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producer in sand at 6,249-54 ft. Location is in the Carlos Lasso League.

Sutton Drilling Co. will drill a 3,500-ft. test for Drilling & Exploration, Inc., at a wildcat location, 1 Wilkins, in the Maria Dolores Diaz Survey, 3 miles east of Big Foot, in Atascosa County, Southwest Texas.

Big "6" Drilling Co. has moved its rig from a wildcat test it recently completed for Reynolds Metals Co. in Victoria County, South Texas, to a new location to be drilled for the same company in the same area. The initial test, 1 Hall, drilled to 5,200 ft., was quit as a dry hole. Both locations are in the Polito Castillo Survey.

Jett Drilling Co. has been awarded contracts for two more exploratory tests which Sun Oil Co. has projected for Pike County, southern Mississippi. One of these tests, 1 Boyd, is located in 10-4n-9e, about 2½ miles northeast of Felders Camp. The other, 1 Walker, is in 28-4n-9e, ½ mile southwest of Pricedale. Each is projected to 6,800 ft.

Neal Drilling Co. has a new wildcat operation under way for Southern Minerals Corp. at 1 McGrary, in the Knight & White Survey, a mile west of the South Clodine area, in Fort Bend County, Texas Gulf Coast. Hole is projected to 8,000 ft.

Southern Six Drilling Co. has a contract with F. A. Callery, Inc., of Houston, for a projected 13,500-ft. test to be drilled 3 miles southeast of Bayou Des Allemands field, in St. Charles Parish, Coastal Louisiana. Location is for 1-A Delta Securities, in 29-15s-21e.

Kern-Trimble Drilling Co., Magnolia, Ark., is drilling for James G. Brown and associates at a wildcat location 2½ miles northeast of Doddridge, in southern Miller County, southwestern Arkansas. The test, 1 Davis, in 7-19s-27w, is scheduled to go to the Travis Peak around 7,300 ft. Location is about a mile southeast of Fort Lynn field. This contractor also has contracted for a 4,000-ft. Travis Peak test to be drilled for Lawton Oil Corp. at a wildcat location between Gum Creek and Wesson fields in southwestern Ouachita County. Location is for 1 Gaughan, in 29-15s-18w.

Petersen Drilling Co., Shreveport, has a contract with J. Paul Ratliff, Jr., independent operator, of New Orleans, for a Wilcox test 2 miles southeast of Ireland field, in northern Wilkinson County, southeastern Mississippi. Location is for 1 Perry, in 18-4n-1w.

MOVE Rigs and set 'em up FASTER with SIMPLEX SCREW JACKS

Many drillers are saving time by permanently attaching Simplex Screw Jacks to the underside of their rig floor. When the rig is to be moved, turnbuckle bracing is unfastened and jack is swung up, out of way. At new location, jack is swung down, turnbuckles attached and jack is ready to level rig. Jack can't get lost, is always available for use.

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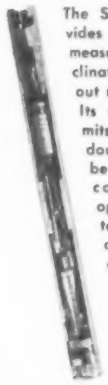

The Sperry-Sun E-C provides a fast, accurate measurement of the inclination of a hole without reference to direction. Its unique principle permits self checking and double checking. It may be run on a wire line or can be go-deviled. It operates on dry cell batteries and is the only inclination instrument which gives multiple records on a single trip. The record reads directly in degrees off vertical within a range of 6 degrees.

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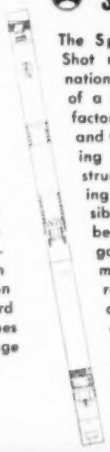

The Sperry-Sun Single Shot measures the inclination and the direction of a hole. It prints both factors on a photo disc and will give a valid reading only when the instrument is at rest, making false readings impossible. The Single Shot may be run on a wire line or go-deviled into a nonmagnetic drill collar or run on a wire line in open hole. Interchangeable angle units with ranges from 0° - 20°, 0° - 40°, 0° - 90° are available.

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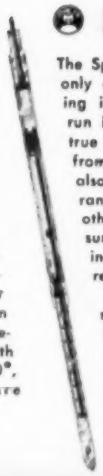

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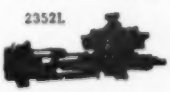
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LEADING THE FIELD OF SEISMIC EXPLORATION

EXPLORATION

Is West Texas in a Slump?

by Philip C. Ingalls

WEST Texas is a fabulous producing province. For 30 years it has been the scene of one inspired play after another. It is still an exciting prospecting area and one that will provide many more big oil fields before it settles down to a routine producing existence.

During the early years of West Texas' development there were many times when it looked as though the area was through—as if the field being drilled was to be the last big one. The province was considered to be too far from markets ever to be a big producer. Furthermore, the characteristics of the crude made it undesirable. That kind of thinking is gone. There are no West Texas skeptics today.

There is, however, considerable concern being expressed in some quarters over the declining drilling activity in this producing province. There is a marked decrease in the number of wells being completed in West Texas and rigs are drifting to other areas. Drilling activity in West Texas is down, decidedly down; but, the obvious question is, "down from what?"

West Texas drilling is down from an abnormal peak of activity which developed with the discovery of the Scurry County reef fields and continued almost without a break through the initial development surge of the Spraberry Trend. Though drilling activity in West Texas is down, it is down to a high level, a level that reflects the continued growth of interest in the future potentialities of the area.

During the past 10 years or so West Texas operators have been moving in on a new subprovince between booms in older ones. This new subprovince consists of the rocks beneath the prolific Permian beds on the Central Basin platform and to the east into the Midland basin.

Though the 1928 discovery of the Big Lake-Ellenburger pool was proof that deep rocks in the Midland basin were oil bearing, the initial campaign for pre-Permian production was essentially restricted to the Central Basin platform where these rocks could be checked at moderate depths. Then came the discoveries of Benedum, Pegasus, and other Ellenburger and Devonian fields in Upton and Midland

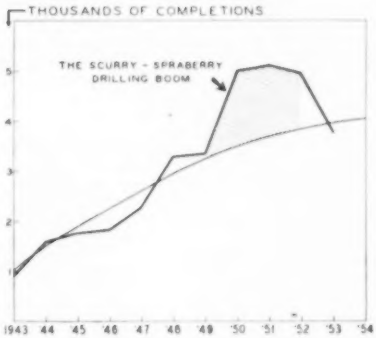


Chart showing the abnormal level to which well completions had climbed in West Texas during the 3-year period immediately preceding 1953.

counties to attract additional prospecting into the depths of the Midland basin. The results of current wildcat drilling to pre-Permian objectives, especially the Devonian and Ellenburger, continue to expand the recognized potentialities of the deeper rocks on and to the east of the Central Basin platform. Prolific production is being opened by these wildcats which often find plug-back possibilities in the Pennsylvanian and Wolfcamp or even younger Permian rocks.

Andrews County is especially prominent in the deeper-rock search both on the Central Basin platform and to the east in the Midland basin. Wildcat activity in the eastern portion of this county got under way last year with the discovery of Magutex-Ellenburger. Subsequent drilling in the Midland basin portion of Andrews and Ector counties and north of the Central Basin platform near the New Mexico line in Yoakum County has seen the discovery of oil in the Silurian, Devonian, Mississippian, Pennsylvanian, and Permian, as well as more in the Ellenburger. Though there are still many unanswered questions involving structure in this area of deep-seated folding there are many indications that this new province is going to develop into another major producing area for West Texas.

There's no real slump in West Texas. Activity is still high in this area which unquestionably is one of the greatest future provinces in the United States. Because of jealously guarded lease holdings, such booms as were featured by the Scurry reef fields and the Spraberry Trend may never develop again, but it can be expected that drilling in West Texas will be at a rate that will hug or surpass the 4,000-well per year mark in the long-range picture.

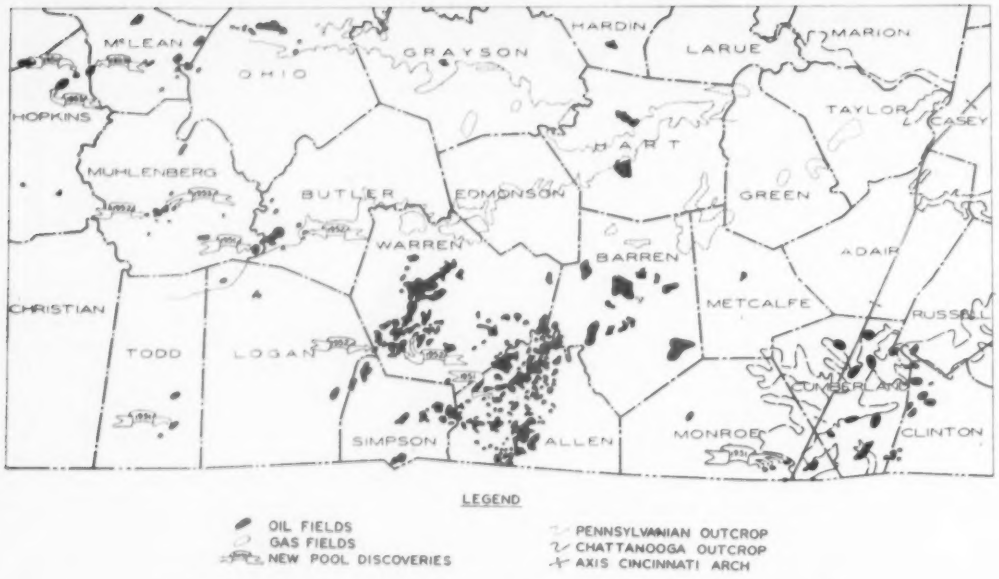
HIGHLIGHTS OF WEEK'S DEVELOPMENTS

WEST TEXAS . . . Forest Oil Corp. and Monterey Oil Co. have a flowing discovery at 1-C University, north-central Andrews County wildcat. The strike, which is located in an undrilled area, flowed oil on a drill-stem test at 10,619-59 ft. from what is believed to be upper Pennsylvanian lime.

COLORADO . . . Petroleum, Inc., recovered oil from the "J" sand in commercial quantities at 1 Clar, SE NE NW 24-1n-58w, Morgan County Denver-Julesburg basin wildcat. Earlier the wildcat had recovered substantial quantities of oil from the "D" sand.

OKLAHOMA . . . A Lincoln County discovery has established a high flow rate after fracture treatment on open hole in Prue sand pay. Charles H. Mee 1 Turner, SE SE SW 22-17n-2e, flowed oil at the average rate of 12½ bbl. per hour for 6 hours. The flow was on 19/64 and 21/64-in. chokes. The discovery, which is 1¼ miles west of Perkins pool, also had a gas volume estimated at 2,500 to 3,000 M.c.f. per day.

EAST TEXAS . . . The first Smackover production in Franklin County is indicated in New Hope field at Tide Water Associated Oil Co. 1 Ramey unit. Turned to tanks, the well flowed 37 bbl. of 55°-gravity distillate in 6 hours and still was flowing at last report from 12,086 to 12,272 ft.



Map of southwestern Kentucky showing location of oil and gas producing areas.

New Finds Spur Oil Search in Kentucky

Here's a county-by-county description of current developmental activity

by W. D. Chawner

NEW oil has recently been found in southwestern Kentucky. Even though the new pools seem to be small and have not added much to reserves, they have encouraged operators to continue the search for new production in the many large virtually untested areas in the area. There is plenty of room for the existence of some important, as yet undiscovered, oil pools within these areas.

Production from the oil and gas pools of southwestern Kentucky has come from many different zones ranging in age from Ordovician through Pennsylvanian. Fig. 1 shows the locations of these producing areas. Several of these pools may have been producing as much as 80 or 90 years ago. Most of the pools shown have been abandoned.

The oldest known oil-producing well in southern Kentucky was drilled for salt brine in 1819 in McCreary County just east of the Cincinnati arch on the south fork of the Cumberland River. It struck oil at a depth of a few hundred feet. The oil was probably not used for any commercial purpose, but the knowledge of underground deposits of oil in this area was thus established.

The second oldest known producing well was also drilled for salt water, in Cumberland County, in 1928, on Rennox Creek near Burkesville. It became known as the Great American Well, and the oil was bottled and sold for medicinal purposes under the name of "American Oil." It was pumped until 1860, depth was 175 ft., and the producing horizon was probably the upper Sunnybrook of Trenton age.

Actual oil exploration and development in southwestern Kentucky began about or shortly after 1860. A. C. McFarlan, in "Geology of Kentucky" is authority for the information that Kentucky's earliest oil exploration and development took place in Allen, Cumberland, Barren, Wayne, Russell, and Clinton counties, and from these beginnings it has spread to about half of the counties of Kentucky.

Paper presented at the meeting of the Kentucky Oil and Gas Association at Lexington, June 4-5, 1953.

THE AUTHOR

W. D. Chawner is district geologist for Carter Oil Co. at Bowling Green, Ky. His geological experience includes 6 years with Atlantic Refining Co. in Colombia, Venezuela, and Peru; 1 year with the Louisiana State Geological Survey; 5 years in New Guinea with Island Exploration Co. and Australasin Petroleum Co.; and 11 years with Carter.

Cumberland and Monroe

Oil production in Cumberland and Monroe counties has come chiefly from rocks of Ordovician age in the Trenton and Stones River groups. In these counties these formations are only a few hundred feet below the surface. Production is usually from horizons 400 to 800 ft. deep.

The old fields in the central and northern parts of Cumberland County produced mostly from the Sunnybrook or the Granville formations of Trenton age. Those in the southern part of the county produced chiefly from Stones River limestones. Recent production in the southeastern corner of Monroe County is reported to be from the Granville (Trenton) and the Stones River.

Recent activity in Cumberland County has consisted chiefly of shallow tests of the Trenton, mostly near older areas of production, in an effort to

extend those areas. Some of these wells have found considerable additional oil but no significant amount of reserves.

Beginning in October 1951 with the discovery of a new field on Little McFarland Creek in southeastern Monroe County, there was a considerable increase in activity in this area and southwestern Cumberland County.

In southeastern Monroe, development centered around Little McFarland Creek with about 8 wells, and Capshaw Hollow (including Spears store) with 31 wells. Capshaw Hollow pool produced about 500,000 bbl. of oil from 31 wells 400 to 700 ft. deep, from the Trenton. These wells initialed from 200 to 800 bbl. of oil per day but dried up in 4 to 6 months. The drop in production came suddenly. One operator reported a well which produced 265 bbl. of oil per day steadily for about 6 months and then dried up practically overnight.

Allen and Simpson

Most, if not all, of the production in Allen County and eastern Simpson County has come from rocks of Silurian age at or near the base of the Chattanooga black shale, at depths of 100 to 500 ft. Allen County is covered with old producing fields now largely played out. However, there has been some new production either close to or within old areas of production. One such area is located near the community of Halfway, in western Allen County, where Morgan Petroleum Co drilled six or seven producing wells.

Warren County

Eastern Warren County production also has come chiefly from Silurian formations, or from a thin layer of Devonian limestone, often sandy, at or just below the base of the Chattanooga shale, and immediately and unconformably overlying Silurian limestones. There has been no recent new discovery in this area.

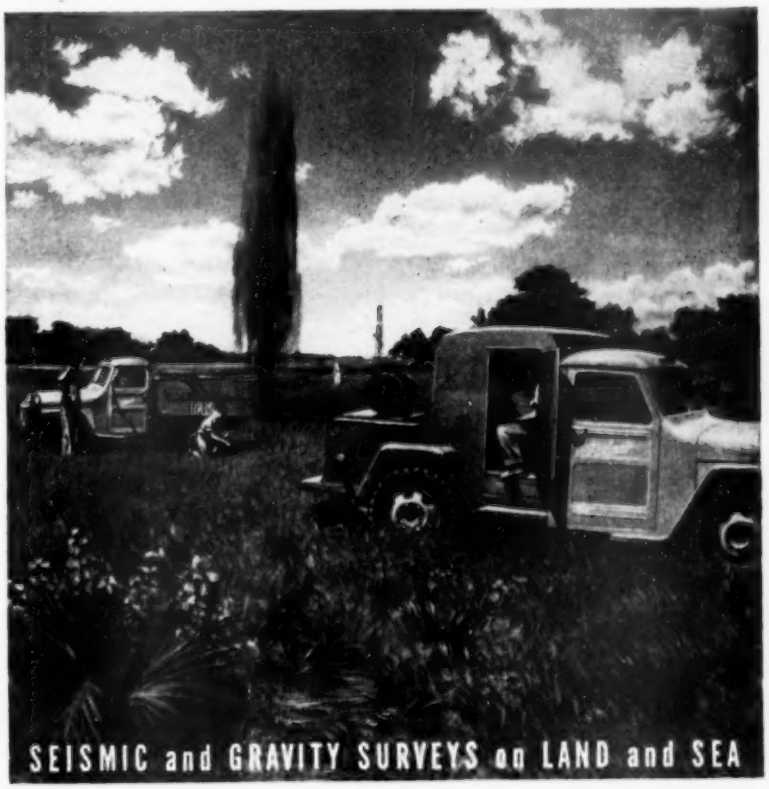
Central and western Warren County has probably been the largest oil-producing area in southern Kentucky west of the Cincinnati arch and south of the Rough Creek fault. The main Bowling Green pool, with its northeast extension, and several other smaller pools to the southwest, produced mainly from three or more zones of porosity in the Devonian limestone, from about 900 to 1,000 ft. in depth. At least 10 million barrels of oil, and perhaps more, was produced from these fields.

There were once many pools scattered in a wide belt across Warren County, which produced from the Mississippian-Warsaw formation, at depth of 400 to 500 ft. This Warsaw oil usually produced rapidly for a few days under heavy pressure and then played out. There were some exceptions to this rule, however, where wells of smaller initial production lasted a long time. A great deal of water was often encountered in this formation, and water and oil were produced together. In other cases no water was ever produced, only oil or gas or both.

Both the old Devonian production in the Bowling Green area, and the Warsaw production have largely played out. However, there has been a good deal of persistent drilling on the part of operators trying to extend the old areas of production or to find new pools in undrilled areas between the old pools. Some new oil has been found this way, chiefly from the Warsaw formation, but no significant pools have been found. The new oil production has been chiefly southwest of Bowling Green in the Rockfield and Lost River areas.

Logan County

Logan County has not received the same amount of drilling activity as has Warren County, largely because it is farther away from the old Warren County production. However, one new pool has been opened. This is the



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Shakertown pool, with nine producing wells from the Dutch Creek sand. The Dutch Creek sand is the basal member of the Devonian - Jeffersonville limestone, found at about 1,000 ft. The discovery well initialed 10 bbl. of oil and 2 million cubic feet of gas. Several of these wells made initials of 50 to 60 bbl. of oil per day, but now, 15 months after discovery, the pressure has dropped and wells are reported to produce 4 or 5 bbl. of oil per day each.

It is reported that the old Gillespie pool, just over the line in Warren County, probably also produced from this Dutch Creek sand. This suggests the possibility that there may be other larger sand lenses at the Dutch Creek horizon which have not yet been found by the drill and which may some day produce oil.

Recently there has been a considerable amount of exploration in Logan County. Several wells have been drilled to the Devonian and the Silurian in the northeast part of the county near Richelieu, and others were drilled in the vicinity of Russellville. Many of these had significant and encouraging shows of oil, but there has not yet been any further discovery of commercial production. There are some small older pools in the northwestern part of Logan County, one, the Lewisburg pool, about 1 mile east of the town of that name, has several old wells still producing from the McClosky and the Bethel. The old Diamond Springs pool is located about 4 miles northwest of Lewisburg, and it has produced some oil from the St. Louis and the McClosky.

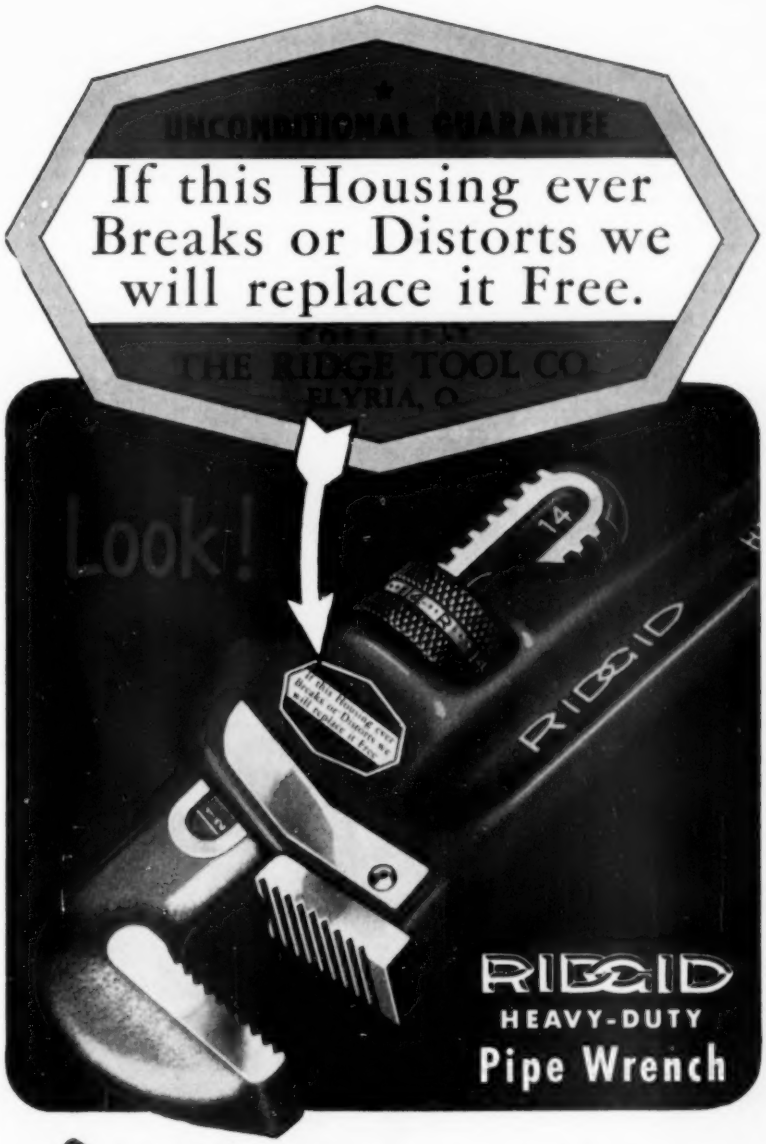
Todd County

Up until 1950 Todd County had no commercial production of oil. The first commercial well was drilled in April 1950. It initialed 50 bbl. of oil per day from Devonian limestone at 1,202-09 ft. The pool was named after the community of Hermon, and nine producers were completed which have accumulated a modest 60,000 bbl. of production, it is estimated.

Northeast of the Hermon pool about 2 miles, four more wells were drilled in for 18 to 70 bbl. of oil per day from the same Devonian horizon. This pool was named Hermon-East. It was extended eastward in September of last year by a Silurian well at 1,239-52 ft. which initiated 120 bbl. of oil per day after 1,000 gal. of acid. Some dry holes have been drilled here since, but nevertheless, it is expected that this area of production can be enlarged and extended.

Butler County

Huntsville pool in southwestern Butler County was discovered in 1939 and has slowly expanded to over 200 wells



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producing from Chester sands, chiefly the Hardinsburg (Jones) at depths of 350-500 ft. Ultimate recovery is roughly estimated at 1½ to 2 million barrels. Other small pools in this area producing from Chester sands are Mt. Zion, Rochester, and Pleasant Hill pools producing from Tar Springs sand, and South Hill pool producing from Hardinsburg. The latter has been recently extended southward near Beech Grove School, and there are probably more than 50 wells altogether, including old producers now abandoned in the older part of the field. A few of the more recent wells have also produced from higher Chester horizons. Average well production has been very low, but depths are very shallow, 180 to 450 ft.

Muhlenberg County

The old Greenville pool, about 1 mile south of the town, produced gas from the Pennsylvanian and oil from the Aux Vases and the Ste. Genevieve. One well is reported to have produced 100,000 bbl., but that is unverified. There is still small production from some of these wells which were drilled in 1930-1933.

More recently oil has been found in Rhoades School pool, 2 miles southwest of Greenville. Seven wells are producing here now from Bethel (or Benoist) sandstone at about 1,550 ft. The discovery well initialed 10 bbl. of oil per day on pump from a depth of 1,537-50 ft. The second Ringo well pumped 64 bbl. of oil per day, and the third made 260 bbl. on pump.

Recently, two other areas east of Greenville have found new production. An eastern extension of the old Greenvill pool on the country-club grounds, found oil in the Bethel, and several tests in the Buck Knob area produce from the Paint Creek sand. Active exploration is in progress in these areas at the present time.

In eastern Muhlenberg County, Huntsville pool has been extended across the county line from Butler County within the last 2 years, and an outlier extension to the southwest, Roy or Hunts School pool, is producing from the "Jackson" (or Big Clifty) sand.

It is difficult to gather information in this southern part of Kentucky where there is no active scouting service. Such things as production figures, samples or sample logs and drillers logs, are often not kept, or are inadequate or unavailable. Much information which would be valuable to the oil industry as a whole is therefore irretrievably lost. The Kentucky Geological Survey at Lexington accepts all well samples and well information made available to it. All operators who drill in these areas should be encouraged to collect samples, together with drillers' logs, and turn them over to the survey with adequate depths, names, and location descriptions properly affixed. The operators themselves will directly benefit from such a policy if generally applied and the information used by all operators.

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MICHIGAN

A new shallow Traverse district oil discovery well appeared assured at the James J. McGerry, Trustee 1 Honrich, NW SE NW 33-8n-13w, Wright Township, Ottawa County. Wildcat, located about 4 miles northwest of the older and large Walker Traverse oil pool, and on the same general trend, was reported to be flowing (oil and water) at a restricted rate of from 3 to 5 bbl. an hour after a 500-gal. acid treatment to 1,800 ft. of fluid which showed natural in 18 hours. At last report well was continuing to flow at a hard and steady rate on the seventh day after treatment despite a water-cut which has been reported in varying amount from a low of from 3 to 5 per cent, last report, to a high of about 80 per cent. Water appears to be coming in slugs. Origin of this water-cut has not been definitely determined. Hole was making considerable water from up the hole when 5-in. casing was set on a packer, but at least a portion of the water is believed to be from the Traverse pay horizon.

Traverse lime was logged at 1,919 ft., not structurally high in correlation with control points in the area. Pay showed at 1,920-21 ft.

and hole is now bottomed out at that point. There appears to be good evidence of structure in the area, and like other Traverse pools this favorable porosity condition appears to be on the flank, rather than on the top of the structure.

During the first 4 hours after the acid treatment, well flowed back 110 bbl. of net fluid, showing a 3 per cent water-cut. During the next 5 hours a total of 50 bbl. of fluid was recovered. Various choke arrangements have used during these early test runs. At present time it appears that production will be restricted to about 5 to 6 bbl. an hour where water-cut appears at a minimum.

Considerable gas is in evidence at this wildcat. Casing pressure has shown at a high of about 790 psi., with tubing pressure at 400 psi. Additional tests were being run this week.

CANADA

Four Gas Strikes Hit in Western Area

Four Alberta exploratory ventures chalked up discovery of natural gas during the past week, to highlight the western Canadian petroleum and natural gas search. In addition to the four discovery wells a gas extension test in the vicinity of a pair of the gas discoveries was also assured of success.

Two of the gas discovery wells were drilled in the Pouce Coupe region of northwestern Alberta, as was the gas extension success, while the other two gas strikes were recorded in the Sunnynook area of southern Alberta and the Pine Lake area in the central portion of the province.

The gas finds in the Pouce Coupe area, near the British Columbia border, 15 miles east of Dawson Creek and around 60 miles north of Grande Prairie, include: Canadian Northern-Pacific 1 and 2 South Pouce Coupe wells. The No. 1 well, LSD 1, 12-78-13w6, around 12 miles south of Pouce Coupe gas field, was chalked up as a gas discovery in both the Cadotte and Triassic formations. That well found approximately 100 ft. of gas pay formation in the Cadotte zone, flowing natural gas at rates up to 2¾ million cu. ft. daily during drill-stem tests. The second Pouce Coupe discovery, drilled on LSD 9, 5-78-12w6, 3¼ miles west-southwest of the first strike, found its gas in the Doe Creek sand, a formation lying between the Cardium and Dunvegan—a zone that had not previously given up natural gas in commercial volume in western Canada. This well also found gas in the Cadotte sand.

The gas extension success, a joint venture between Pacific Petroleums, Ltd., Canadian Atlantic Oil Co., Ltd., and Royalite Oil Co., Ltd., found its gas in the Cadotte. This well, Pacific-Royalite 1 Pouce Coupe, LSD 7, 20-80-12w6, is about 12 miles north of the two new gas discoveries and 2 miles east of the previous known limits of Pouce Coupe gas field.

The Sunnynook gas discovery, some 100 miles east of Calgary, was drilled by Amurex Oil Development Co., on farmout from Anglo Canadian Oil Co., Ltd. This well, Amurex-Anglo Canadian 16 Sunnynook, LSD 6, 29-26-13w4, 5¼ miles northwest of Sunnynook oil production, rated an initial potential of 1,000,000 cu. ft. of gas daily from the Viking sand formation. The 16 Sunnynook was carried down to the Basal Cretaceous and production casing was set. The basal quartz gave up a moderate flow of gas on drill-stem test, but was not tested after casing was set.

The gas find in the Pine Lake region, 15 miles east of Innisfail and 68 miles north of Calgary, encountered nearly 100 ft. of Mississippian formation that yielded sizable flows of natural gas during drill-stem tests. This venture, Amurex-Calvan 1-3 Three Hills Creek, LSD 3, 30-35-25w4, is scheduled as a test of the D3 Devonian. The well flowed gas at rates from 440,000 to 1,205,000 cu. ft. daily during tests in the Mississippian below 5,688 ft. Crew has resumed drilling and is now heading in search of lower productive horizons.

EASTERN CANADA

Ontario . . . In Metcalfe Township, Middlesex County, Union Gas Co. of Chatham has started the first of a series of test holes on the Roy Phillips farm, Concession 12, 4 miles from Strahroy. Union has leased extensive acreage in Metcalfe Township and vicinity, and is planning a systematic development program, itself taking any gas production secured, while Imperial Oil will take any crude developed. The area, north and east of Mosald field, is practically untested, and the Guelph-Niagara is the potential producing horizon.

Gaspe . . . In the Gaspe Peninsula, Quebec Province, The 2 Bald Mountain, with a fishing job at 5,968 ft., is cleaning out and preparing to drill past the tools following a shot. On the Galt Brook dome, the Continental Oil Co. 1 deep test is fishing at 3,226 ft. The 1 Asphalt Base is drilling hard gray limestone below 1,812 ft. with a small recovery of black crude from the upper formations.

INDIANA

In Dubois County Elmer Novak and Aaron Karchner have the first Cypress production

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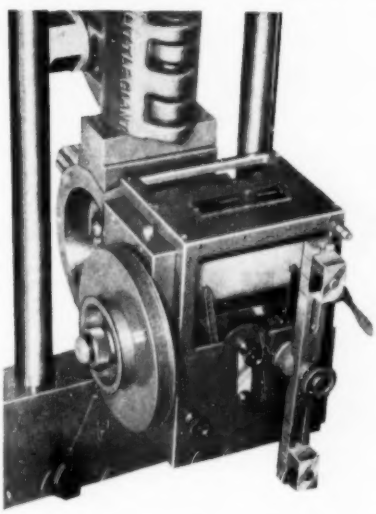

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in the county at 1 Fuhrman, SW NE SE 13-1s-5w. The discovery flowed 4 bbl. of oil per hour after fracturing through casing perforations at 469-86 ft.

KANSAS

Nomenclature Committee Names New Pools

The Nomenclature Committee of the Mid-Continent Oil and Gas Association has given names to 13 new oil and gas pools in Kansas.

Southeast Kansas . . . In Butler County Stelbar Oil Corp. opened Mount Tabor pool at 1 Stolebarger, CN½ NE NW 36-29s-4e. The Bartlesville discovery was completed for 25 bbl. of oil per day.

Arrow points to Skelly Oil Co.'s 3-mile northwest extension of McKinney gas field in Meade County. The 1 Ediger, NW NW SE 11-33s-27w, flowed 10,004 M.c.f. of gas per day after fracture treatment of perforations at 5,715-38 and 5,686-91 ft. The discovery is in the highly active Hugoton embayment, east of the Hugoton and Kismet area gas fields. The Chester was topped at 5,688 ft.

Central Kansas uplift . . . At the far northwest end of the uplift in Decatur County Polinow West pool was opened by M. B. Armer 1 Schultz, NE NE SW 5-3s-29w. The well is completing in the Lansing. Elsewhere on the uplift in Ellis County Braun pool is opened by Elreco and Rock Island Refining Co. 1 Braun "D," NE NW SW 34-13s-16w, finished for 240 bbl. of oil per day from the conglomerate.

On the southwest side of the uplift in Pawnee County, Oro West pool is opened by Carl Todd Drilling Co. at 1 Pfenninger, C NE SW 8-20s-19w, with pump potential of 281 bbl. of oil daily from the conglomerate. Hearn pool is a new Ellis County discovery, opened by Natural Gas & Oil Co. 1 Hearn, SE SW NE 35-23s-15w, completing in the Lansing. In Rice County Staatz pool is opened by Beardmore Drilling Co. 1 Staatz, SW SW NE 15-18s-9w, finaled for 135 bbl. of oil per day from the conglomerate.

Paradise Creek West pool is a new Rooks County pool, opened at Heathman & Co. 1 Baumgartner "B," CN½ NE NE 20-9s-18w, completing in the Arbuckle. Northampton Southeast pool is also a new Rooks discovery at Francis Oil & Gas Co. 2 Wilson "C," NW NE SE 35-9s-20w, also completing in the Arbuckle. Stafford County's new pool is Green Ridge pool, opened by Greenland Drilling Co. 1 Cadman, NW NW NE 30-23s-14w, finaled for 162 bbl. of oil per day from the Lansing.

Sedgwick basin . . . The Texas Co. 1 Jake Graber opened Orsemus pool in the SE NE SW 30-29s-5w, Kingman County, for a bomb potential of 1,901 bbl. of oil per day from the Simpson for the most significant new strike in the state this year. Bacon pool is a new discovery for Reno County at Pam-Kar Drilling Co. 1 Bacon, NE NW SW 36-23s-5w, finaled for 178 bbl. of oil per day from the Mississippi.

Sumner County has two new pools. Hilltop pool was opened by Orville Parker at 1 Hansen, SE SE SE 26-34s-2e, finished for 10 bbl. of oil per day from the Bartlesville sand. L. C. Smitherman 1 McCorgary, SE SW SE 14-35s-2e, finaled for 200 bbl. of oil daily from the Cleveland sand, opened State Line pool.

ROCKY MOUNTAIN

SOUTH DAKOTA

Shell Gets First Apparently Commercial Show

Shell Oil Co. recovered free oil and highly oil and gas-cut water on test of 1 State, A, SW SE 9-21n-4e, Harding County, South Dakota for the first commercial appearing show in the state.

Test was of the interval 8,589-8,604 ft. With tool open 1½ hours recovery was 570 ft. of black, 22.1°-gravity oil, 90 ft. of highly mud and gas-cut oil, and 100 ft. of highly oil and gas-cut water. There was an immediate blow, increasing to good after 10 minutes, and remaining steady for the remainder of the test. Flowing pressure was 160-175 psi., and shut in pressure was 3,012 psi. Test was in the Red River member of Ordovician. Shell will core ahead about 15 ft. and run a second test.

The wildcat is on seismic prospect in the Custer area. The operator is reported to hold about 11,500 acres in the general vicinity. It is some 30 miles southeast of production in Ordovician at Little Beaver field, Fallon County, Montana, and is about 75 miles south of nearest production in North Dakota at the Fryburg discovery in Billings County.

A considerable exploratory program which has been under way steadily in the state since discovery of oil in the North Dakota portion of the Williston basin has brought very little previous encouragement. The apparent Harding County discovery is about 6 miles northeast of a recent Carter Oil Co. wildcat which had slight shows in the Red River.

Some shows were also reported in Madison (Mississippian) at the Shell wildcat.

MONTANA

Pipe Set at McCone County Wildcat

R. V. and T. F. Hodge of Bismarck have landed casing at 1 Eggebrecht, C SW SE, 2-23n-49e, in the West Richey area of McCone County. The operators will test shows in Madison and Silurian. Slight shows found in Red River (Ordovician) were apparently noncommercial. Total depth is 10,000 ft. in Ordovician. The well was plugged back and casing landed at 9,600 ft.

Abandon Chouteau Wildcat Another at Decisive Depth

Milton Spencer, Montana independent, has abandoned 1 Carpenter, NE NE SW 22-27n-7e, first Chouteau County test in the current exploratory program through the county to reach critical depth. Cores recovered from Madison had saturation, but were of low permeability and porosity. Conclusive test was not possible due to failure to obtain shut off of uphole water. A core barrel was lost in the hole below 2,762 ft. prior to abandonment.

Continental Oil Co. is drilling into Madison at 1 Lennington, SW NW NW 24-27n-7e, the second well in the area to reach the formation. The operator recovered shows in the top of the formation and has landed pipe at 2,735 ft., although no water has been reported in this well. A core drilling program through the county was conducted by Continental about a year ago.

NORTH DAKOTA

Renville County Gas Discovery Indicated

Leach & Kelsch of Bismarck have tested an undisclosed quantity of gas at shallow depth in 1 Brudvik, NW SW 21-161n-84w, Renville County. While the rate of flow is not reported, the operator has reported the discovery as commercial. Total depth of the well is 303 ft., and production was found at 302-03 ft. Flowing pressure was 70-102 psi., through ¾-in. choke. A first test of this area by the North Dakota independent firm was dry. A third well is under way at 1 Gehringer, NW NW NE 21-161n-84w. North Dakota has not had a commercial gas discovery since the discovery of gas in the southeastern Cedar Creek anticline prospect in Bowman County more than 20 years ago.

Union Oil to Start Core Program

Union Oil Co. of California has announced that a 40-day program of core drilling in Cavalier County will begin in the near future. The program will attempt evaluation of a reported 1,500,000 acres of leases held through this area by Union and by Hancock Oil Co. and Signal Oil Co. All three operators have been active in some exploration on the east side of the Williston basin during the past two years.

NEBRASKA

New Cheyenne County Pool Opener Tested

Ohio Oil Co. recovered substantial quantities of oil on two "D" sand drill-stem tests at 1 Engelland, SE NW SE 33-15n-49w, Cheyenne County. The operator tested 4,574-84 ft. for recovery of 2,850 ft. of oil in 30 minutes. There was gas with the oil at the rate of 118,700 cu. ft. per day. A second test 4,584-94 ft. made 3,180 ft. of oil and 180 ft. of gas cut mud in 30 minutes, with gas at the rate of 130,500 cu. ft. per day. Commercial gas was recovered uphole. A test 4,540-56 ft. recovered gas at the rate of 4,051,000 cu. ft. daily and another 4,564-74 ft., made 1,875,000 cu. ft. per day. The operator is preparing to run drill-stem test of the "J" sand with total depth at 4,589 ft.

WYOMING

South Glenrock Area Discovery

Canada Southern Oils, Inc., has reported a swab gage of 216 bbl. of oil per day from 1 Macauley-State, C SW SW 23-33n-76w,

discovery 2 miles east of production in South Glenrock field of Converse County. Production is from the zone 5,525-37 ft., with casing landed at 5,692 ft. The muddy sandstone is the producing formation, and oil is 38° gravity, similar to production in South Glenrock field proper.

Sublette County Wildcat Recovers Gas

General Petroleum Corp. recovered gas at the rate of 1,400,000 cu. ft. per day on test of the interval 7,225-61 ft. at 18-20 Unit, SW SW SW 20-28n-113w, Sublette County. The blow increased to this maximum after a 2 hour and 20 minute open period. The wildcat is in the Tip Top area, and is scheduled to test to Beckwith at about 8,500 ft. Present total depth is 7,363 ft.

COLORADO

Morgan County Discovery Tested

Petroleum Inc., Denver and Wichita independent has recovered oil in commercial quantities from both "D" and "J" sands at 1 Clar, SE NE NW 24-1n-58w, Morgan County. Test of the "D" sand interval 5,651-61 ft. recovered 2,010 ft. of oil in 1 hour. Flowing pressure was 990 psi., and shut in pressure was 1,520 psi. Top of "D" sand was found at 5,637 ft. A later test of the "J" sand at 5,712-42 ft. recovered 885 ft. of oil and 180 ft. of oil and gas-cut muddy water in 1½ hours. There was gas at the surface after 20 minutes. Flowing pressure on this test was 0-270 psi. Completion is expected in the "D" sand.

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Carter Oil to Drill In Baca County

Carter Oil Co. is reported completing plans for a 6,500-ft. test to Arbuckle in the south central portion of Baca County. The wildcat is an expression of recent interest in southeastern Colorado resulting from new developments in the west side of the Anadarko basin in Kansas and Oklahoma. Carter has completed a considerable geophysical program through the area. British-American Oil Producing Co. is also interested in the venture.

Logan County "J" Sand Discovery Tested

Shell Oil Co. recovered gas at the rate of 4,500,000 cu. ft. per day with 600 ft. of oil on 30-minute test of the "J" sand interval at 1 Budin, C SW SE 2-8n-55w, Logan County. Gas flowed after 4 minutes. Flowing pressure was 600-700 psi., shut in pressure 1,440 psi. Top "J" sand is at 5,250 ft. Total depth of the well is 5,276 ft. Shell has run casing and is waiting on cement.

OKLAHOMA

High Volume Gas Well Tested in Okfuskee Field

A high volume gas well is being tested off the south flank of Okfuskee County's Deaner pool in east-central Oklahoma. George D. Blaylock and W. W. Dyer 1 Wright, NW NE SE 28-11n-11e, flowed 45,000 M.c.f. of gas per day with rock pressure of 1,050 psi. from the Wapanucka sand topped at 2,863 ft. This well is about ¼ mile southwest of the nearest oil producer on the south side of Deaner pool.

ARKANSAS

New Gas Field Opened In Franklin County

Wataluia field is a new sweet-dry gas reservoir in Franklin County, in the west-central part of the state.

Arkansas Western Gas Co. has three rigs in the new field. The discovery well, 1 A. J. King, 4-10n-27w, was completed in October for a calculated open flow of 16,000 M.c.f. of gas per day from the Atoka sand perforations at 2,686-2,810 ft. This new significant find is located 2½ miles northwest of White Oak field and 4¾ miles northeast of Lone Elm field, and is located on the same surface anticline as Lone Elm wells.

KENTUCKY

EASTERN KENTUCKY

In north central Kentucky, Robertson County, John Showalter et al have drilled 1 Jett, a rank wildcat located just north of town of Piqua. Well is currently bottomed at 1,000 ft. in the Knox (Cambro-Ordovician) dolomite with drilling crew waiting on orders.

In the Pike County sector of Big Sandy gas field, United Fuel Gas Co. has completed 50 Kentland Coal and Coke Co. for an open flow potential of 474,000 cu. ft. of gas daily from Devonian black shale 3,939 to 4,885 ft. total depth.

TEXAS

EAST TEXAS

Smackover Oil Prospect First in Franklin County

A new pay in Smackover limestone for the New Hope field of south Frankline County has been assured by Tide Water Associated Oil Co. and Seaboard Oil Co. 1 Ramey Unit. The well flowed 114 bbl. of 57° oil in 11 hours through ¼-in. choke on drill-stem test from 12,088-12,182 ft. Gas rate was 1,236,000 cu. ft. daily.

Operators cored ahead to 12,234 ft., recovering 34 ft. of limestone with gas odor, and another 50-ft. core was scheduled. Previous production in the field has been from the Rodessa, Pittsburg and Travis Peak.

Collin County . . . Humble Oil & Refining Co. 1 Miller, rank wildcat 3½ miles west of McKinney, was unofficially reported to have found oil shows around 9,400 ft. Protecting string was set to that depth and coring started, which at last report was said to be below 9,700 ft., and in the Ordovician system.

Freestone County . . . Pure Oil Co. 1 Knight, wildcat just southeast of Freestone, reported light oil shows in the upper Pettit limestone. Operators drill-stem tested from 8,300-35 ft. but recovered only 90 ft. of slightly gas-cut mud, plus 1,500 ft. of salt water. It was drilling ahead.

WEST TEXAS

West Midland Wildcat Has Pennsylvanian Show

Rowan Drilling Co., Inc., and Cosden Petroleum Co. 1 Roy Parks, 4 miles west of Parks-Pennsylvanian production, developed 110 ft. of free oil on a drill-stem test in the upper Pennsylvanian between 10,024-10,070 ft. Recovery also included 1,000 ft. of heavily oil and gas-cut water blanket and 30 ft. of heavily oil-cut mud. Drilling continued, on an 11,000-ft. contract.

Location of the wildcat is about 1 mile northeast of the north end of a 17,000-acre block of the Dora Roberts Ranch, recently taken by Cities Service Oil Co. and Forest Oil Corp. (See page 77, The Oil and Gas Journal, August 24, 1953).

In Borden County, The Texas Co. 1-B Clayton had started completion tests. The well flowed 270 bbl. of oil during the first 20 hours of a 24-hour gage, through ½-in. choke from pay topped at 8,075 ft.

Flow Estimated to Be 100 BOPH at Andrews Wildcat

A new producing structure was in prospect for northeast Andrews County, 7 miles northeast of Andrews, at Forest Oil Corp. and Monterey Exploration Co. 1-C University. A drill-stem test in limestone of Pennsylvanian age flowed oil into pits, which observers estimated it to be good for 100 bbl. an hour.

The test was run from 10,618-10,659 ft. Water blanket started flowing in 18 minutes and oil at the end of 22 minutes. Flowing pressure was 430 psi. through top ¾-in. choke. Operators shut it in at the end of 17 minutes and starting pulling the testing tool. This well also recovered clean oil and heavily oil-cut mud in the lower Permian at 9,169-9,218 ft.

Location in 20-4-University Survey is 3 miles east of San Andres production in Means field, and 6 miles northwest of a dual Ellenburger and Devonian well in Northeast Andrews field. Projected depth on the 1-C University was 13,500 ft. to test the Devonian.

The prospector is in a block of 2,574 acres purchased at the University of Texas June lease sale for $975,000. Adjoining acreage to Blocks 19, 20, 29 and 30 are held by Humble, Stanolind and Buffalo Oil Co.

Dawson County . . . W. A. Moncrief has spotted location for an 11,000-ft. wildcat 4 miles northeast of Siluro-Devonian production in the Adcock field, in the northeast corner of the county. Drillsite is in Section 5-33-T7N-HE&WT Survey.

Cambrian Has Light Shows

Republic Natural Gas Co. 1 Hair, Tom Green County wildcat located 1 mile east of San Angelo city limits, developed 540 ft. of gas and 40 ft. of slightly oil and gas-cut mud on a drill-stem test between 5,965-6,000 ft. The section tested was the Wilberns dolomite, topped at 5,815 ft. on elevation of 1,759 ft. Only 15 ft. of Ellenburger was logged from top at 5,800 ft.

Gas-Distillate Extension

Cities Service Oil Co. 1-F Owens, 1¾-mile west extension to production in the Clara Couch area of Crockett County, has been gaged at 62,000,000 cu. ft. of gas daily, plus 2,095 bbl. of 69° distillate, open flow. The yield was 33.8 bbl. per 1,000 M.f.g. Production is from perforations in Cisco limestone between 5,820-86 ft. Location is in Section 17, Block GG.

Humble Oil & Refining Co. and Continental Oil Co. 1-U University, Crockett County wildcat 20 miles northwest of Ozona, recovered 10 ft. of free oil and 30 ft. of heavily oil and gas-cut mud on a drill-stem test from 8,962-82 ft. Location in 17-46-University Lands Survey is on a lease purchased by Continental at the June 19 lease sale. Humble purchased a half interest later.

NORTH TEXAS

Grayson County Discovery Is Completed

Howell, Holloway & Howell 1 Rue, 1 mile northwest of Whitesboro, has been completed as a pumping well. Potential test was 79.7 bbl. of 36° oil a day from perforations between 4,468-72 ft.

New work in Grayson County included a deep wildcat by Standard Oil Co. of Texas 1½ miles northwest of Sherman, on the southwest flank of shallow production in the Sherman field. The project will be 3 Glen D. Woodson, Uriah Burns Survey, A-121. Contract depth will be 10,500 ft.

Another exploratory test for the south half of the county has been scheduled by Sam Lett as 1 Umphress, located 2½ miles northwest of Dorchester, in J. R. Smith Survey. This 6,000-ft. operation is 1¼ miles southwest of Superior Oil Co. 1 Shelton, last reported drilling at 5,970 ft.

An Ordovician test has been scheduled for Palo Pinto County, deepest ever drilled in the county. G. A. Eriksen et al 1 J. P. Heath, Section 60-2-T&P Survey, has been contracted to 7,000 ft., to penetrate and test through the Strawn series and Bend conglomerate. Location is within the Gardner-Conway Bend field which produces from around 3,600 ft.

A new Strawn pool has been opened in

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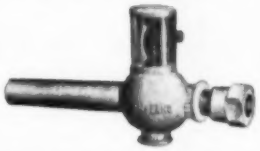

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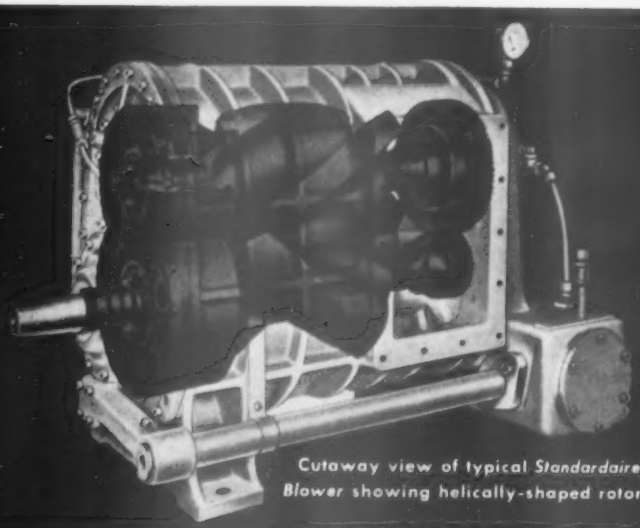

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Fisher County at Trans-Tex Drilling Co. 1 York, 5 miles northwest of Hamlin in Section 190-1-BBB&C Survey. On completion test the well pumped 201 bbl. of oil a day from perforations between 4,481-87 and 4,454-68 ft.

In Shackelford County a depleted Strawn producer had prospects of making a Mississippian discovery. Roark, Hooker & Roark 1-A Elliott, Section 9, LAL Survey, 7 miles south of Albany, ran a drill-stem test in the lower horizon between 4,160-4,315 ft. Gas surfaced in 3 minutes, mud in 27 and oil in 31 minutes. It was not allowed to flow, but unloaded oil and mud while coming out of the hole. Top on the Mississippian was 4,140 ft. Operators plugged back to 4,278 ft. for completion attempt. Previous production was gas from 2,879-85 ft.

TEXAS GULF COAST

North Silsbee Production Extended Southwestward

Yegua production in the North Silsbee area of Hardin County has been extended southwestward with a dual-zone gas-distillate producer completed by Shell Oil Co. at its 1 Kirby, located in Tract 126-A, J. A. Vickers Survey.

The well, drilled to 7,714 ft., has casing perforated in the Yegua 2-B zone at 6,718-23 ft., and the Yegua 1 sand at 6,534-38 ft. From the lower zone, it flowed 23,500,000 cu. ft. of gas daily with a spray of 60.7°-gravity distillate. The upper zone produced 14,800,000 cu. ft. of gas daily with a spray of 60.6°-gravity distillate.

Deeper Pay Zone Opened In New Liberty Producer

New development by The Texas Co. on the northwest flank of the old South Liberty salt dome in Liberty County has resulted in uncovering another deep productive horizon, the second for the area. The new horizon, opened by the company's second well, is in the Cook Mountain formation, producing from casing-perforated interval at 9,007-17 ft. and 9,025-29 ft.

The horizon's discovery well, 2 Wirt Davis, flowed 116.36 bbl. of 36.7°-gravity oil on a 24-hour test through 12/64-in. choke with 400-psi. pressure and gas-oil ratio of 1,176 cu. ft. per barrel.

The area's discovery well, 1 Wirt Davis, located several hundred feet to the southeast and higher on the dome, produces from a somewhat shallower horizon, open at 6,992-7,014 ft. and 7,022-32 ft. It was completed last August.

Drilling now is under way at the company's third test, 3 Davis, located southwest of 2 Davis. It is projected to 12,000 ft.

SOUTHWEST TEXAS

New Gas-Distillate Field Opened in Kenedy County

Another gas-distillate producing area, located 12 miles northeast of Encino, in Kenedy County, has been opened by Humble Oil & Refining Co. with the completion of its 1 Clark and Sain, in the Santa Gertrudis Grant. Location is 1½ miles east of the Brooks County line and 4 miles southeast of Viboras field, in the latter county.

The new discovery well gaged 1,380,000 cu. ft. of gas daily through ¾-in. choke on potential test, and had a gas-distillate ratio of 39,000 cu. ft. per barrel. Flowing pressure

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was 4,120 psi. Gravity of the distillate was 55.9°. Production is from a casing-perforated interval of 9,972-92 ft.

LOUISIANA

NORTH LOUISIANA

Potential Being Taken At Cotton Valley Hit

States Oil Co. is calculating potential after running gages at 1 Wilbert, 8-17n-15w, Cotton Valley strike in Caddo Parish's Greenwood field.

The well flowed 2,600 M.c.f. of gas and 21 bbl. of condensate per million per day on first tests of the "D" sand in the Cotton Valley. The flow came at 8,529-39 ft.

The same operator's 1 K. E. Gulledge unit, SW NE 9-17n-15w, is a confirmation test to this Cotton Valley discovery. Better development of the Bodcaw sand is expected at the confirmation well. The Bodcaw pinches out near the discovery well, it is believed.

Four Wicox Strikes Made in October

Four Wilcox discoveries were completed in North Louisiana during October, three in Concordia and one in Rapides Parish.

Hunt Oil Co. and Gulf Refining Co. completed C-7 Angelina Hardwood Lumber Co. to open North Cocodrie Bayou field, flowing at the rate of 140 bbl. of 42°-gravity oil per day through 12/64-in. choke. Production is through perforations at 6,478-82 ft.

The same operators also completed C-9 Angelina in the C SW SW 17-4n-7e, to open Bee Brake pool. The pool opener flowed at the rate of 165 bbl. of oil per day through 12/64-in. choke through perforations at 6,777-80 ft.

E. C. Wentworth, Justiss-Mears Oil Co. and Barnett Serio Drilling Co. had another Wilcox discovery at A-1 Quinn, 13-4n-6e, about 1 mile west of Bee Brake. It was finaled flowing at the rate of 167 bbl. of 33.2°-gravity oil per day through perforations at 6,578-80 ft. Two offsets have been staked to this strike.

SOUTH LOUISIANA

New Lafourche Discovery Produces Gas-Distillate

A new oil-producing area is being opened by Humble Oil & Refining Co. in the coastal marshes of southern Lafourche Parish. The discovery well, Delta Securities, located in 3-19s-20e, about a mile west of Gulf Refining Co.'s Bully Camp field, flowed on an unofficial test at the rate of 276.38 bbl. of 38.4°-gravity oil daily through ⅛-in. choke, gaging 6,000-psi. pressure on the tubing. Gas volume was 1,025,000 cu. ft. with a gas-oil ratio of 6,151 cu. ft. per barrel. No formation water was indicated.

Production is from a deep Miocene sand, opposite which casing is perforated at 11,845-53 ft. Hole had been drilled to 12,283 ft. Production in Bully Camp field is from sands above 7,985 ft.

Humble already has scheduled the drilling of two offsets to the new discovery well. The large drilling rig has been released from the latter well, and now is on one of the new locations. A workover rig is being moved in to complete the discovery well.

Second Producer Confirms Sullivan's Lake Discovery

Discovery last June of gas-distillate production in the Sullivan's Lake area of Iberville Parish has been confirmed with completion of another producer.

The confirmation well, Union Producing Co. 1 Schwing-Wilbert, flowed at the rate of 3,761,000 cu. ft. of gas daily on its initial test through ⅛-in. choke with 2,600-psi. pressure on the tubing. The gas carried a heavy spray of distillate, but this was not gaged. The well is shut in pending provision of an outlet for the gas.

Production is from a casing perforated interval at 11,036-48 ft. The discovery well, 1 Schwing, also drilled by Union Producing Co., was completed with casing perforated at 10,989-91 ft. and 10,984-11,004 ft. It produced on potential test at the rate of 320 bbl. of 49.9°-gravity distillate with 6,176,000 cu. ft. of gas daily through 5/16-in. choke.

The area is 6 miles northwest of Whitecastle field and about the same distance southeast of Bayou Blue.

ILLINOIS

A 1-mile stepout from Clay County's Flora pool, the William H. Krohn's 1 Chambliss, 19-3n-7e, 1 mile northeast of Flora, is swab testing 5 bbl. of oil per hour natural while cleaning out the Rosiclare lime at 2,980-87 ft.

In Saline County, 5 miles northwest of Eldorado, Breuer-Robison 2 Massey, SW SW

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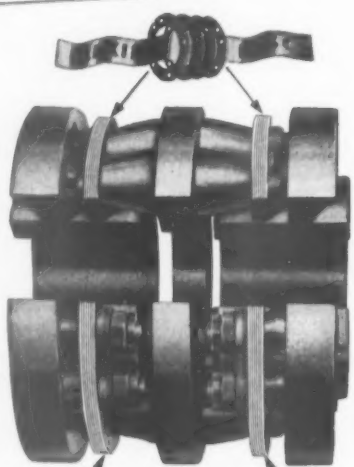

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NE 35-7s-6e, has set casing to test the upper Cypress (Weiler) sand at 2,501-15 ft. A 1-hour drill-stem test recovered 810 ft. of clean oil. The wildcat is 1 mile from other production.

CALIFORNIA

Extension to Coalinga Find Preparing to Start Drilling

A ⅜-mile southeast outpost to the new Leda sand pool discovered 1½ miles west of Guijarral Hills field, Fresno County, was preparing to start drilling. Lloyd Harnish, Opr. 86-32F will be the new test, in NE SE 32-20s-16e.

The operator's 73 well in SE NE Sec. 32 was completed flowing 346 bbl. of 37°-gravity crude from the lower Miocene sand at a depth of about 8,400 ft. Harnish 64, a southwest offset was drilling below 7,100 ft. Russell Giffen had 62 32F under way as a northwest offset.

Reserve Completes King County Field Discovery

Reserve Oil & Gas Co. completed its wildcat at McClure Valley, about ¾ mile south of Pyramid Hills production, Kings County, as a 300-bbl. flowing producer. The flow of 40°-gravity crude was based on a 13-hour test through a 14/64-in. choke. Located in SE SW 20-24s-18e, Reserve 48-20 Orchard is believed to be producing from the third Kreyenhagen sand (Oligocene age) at a depth of approximately 4,390-4,429 ft.

The company was preparing to start 37-20 Orchard as a northwest offset. No other tests had been announced but it was expected two additional offsets will be started in the near future.

Pipe Set in San Benito Test

Tide Water Associated Oil Co. has set 7-in. casing at its wildcat near Hollister in San Benito County, causing speculation that 1 Breen may result in a new field discovery. With hole bottomed at 4,591 ft., pipe was cemented at 4,300 ft. Nature of the showings encountered were not released by the operator. The wildcat is located in SW NE 19-12s-5e. About 2½ miles southeast of this wildcat, The Texas Co. 1 Nutting had reached a depth of almost 2,000 ft.

Newport Beach Test Redrilling

Montery Oil Co. halted drilling at 7,125 ft. in its offshore test being drilled from a site in Newport Beach. The wildcat, which is testing a state-granted lease jointly held with Humble Oil & Refining Co., was preparing to redrill after plugging back to 1,100 ft.

Rosedale Ranch Extended

Standard Oil Co. of California continued to extend productive limits of the Rosedale Ranch field about 10 miles northwest of Bakersfield. Its 21-12 K.C.L. in NW NW 12-29s-26e, approximately ½ mile from production, was being completed in the Lerdo sand after being plugged back to 4,310 ft. Top of the Lerdo pay was called at 4,145 ft. The G.P. 44 sand, which produces in the older portion of the field ½ mile northeast, was found to be wet on a formation test at 4,928-68 ft.

Pipe Set in Tejon Wildcat

J. V. Dougherty & Assoc. have set pipe in the Tejon Flats, Kern County, wildcat which was drilled to 8,796 ft. and then twice redrilled. A 5-in. liner was landed at 8,484 ft. after redrilling from 7,140 ft.

The wildcat, 65-14 "Well" early this year showed promise of being a new oil discovery before mechanical troubles interrupted its completion. The test, in 14-11n-19w, is about 1½ miles northwest of Union Oil Co.'s Reserve-Kerr discovery. Reserve was preparing to drill 44-17 Butler about 3½ miles west of the potential discovery.

APPALACHIAN AREA

WEST VIRGINIA

In Glade district, Webster County, West Virginia, Gregory Gas Co. located 1 D. L. Ellyson, wildcat, elevation 2,345 ft., Cowen Quadrangle, .77 mile south of Lat. 38° 25′ and 2.93 miles west of Long. 80° 30′. West Virginia Gas Corp. 1 Dewey Given, elevation 2,373 ft., resulted in a dry hole, Big lime 1,903-2,120 ft., TD 2,135 ft. Roaring Creek district, Randolph County, Fox-Trimble et al announced 1 James T. & Bernadette Brennan, wildcat elevation 2,480 ft., Sago Quadrangle, 1.77 miles south of Lat. 38° 55′ and 1.80 miles west of Long. 80° 00′. Gore district, Hampshire County, M. E. Anderson 1 Woodrow W. McBride, elevation 1,343 ft., gaging 76,000 cu. ft., gas, rock pressure 1,750 psi., Oriskany sand 5,602-5,734 ft., gas 5,636-5,639 ft., TD 6,030 ft.

WILDCAT COMPLETIONS

SOUTHWEST TEXAS

Atascosa County: Davis & Davidson 1 Chapa, M. Jemtes Sur. 908, A-1317, Dry, TD 2,435 ft.

Sabine Drilling Co. 1 Tomlin, F. A. Michael Sur. 1360, A-588, Dry, TD 2,659 ft.

Sutton Drilling Co. 1 McKinney, H & GN Sur., A-419, IP 96 BOPD, ¼-in., 48°,

GASOLINE GAUGING PASTE FOR THE OIL GAUGER

Gives accurate gauges of light hydrocarbons (Butanes, gasoline, kerosene, crudes). Turns red on contact. Will not creep up gauge line.

WATER FINDING PASTE—Turns red on contact with water level. Assures truer gauges.

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KOLOR KUT PRODUCTS CO.

Box 5415 • Houston 12, Texas

"It's oil, LANE-WELLS on the job"

WILDCAT COMPLETIONS

Navarro 3,687-3,729 ft. TD 3,729 ft. (Extends Big Foot field.)

Bexar County: Thurman Barrett 1 Barrett, Domingo Bustillos Sur. Dry. TD 1,530 ft.

Frio County: Howeth & Mason 2 LaBatt, John B. Uphus Sur. 169, A-646. Dry. TD 3,600 ft.

Howeth & Mason 2 Mowlin, J. W. Crawford Sur. 8. Dry. TD 3,522 ft.

George Parker 1 Howard, Henry Maney Sur. 6. IP 1,400 M.c.f. daily, open hole 3,175-3,244 ft. TD 3,244 ft. (New field.)

Fred W. Shiled 1 Oppenheimer & Lang, BS & F Sur. 9, A-124. Dry. TD 5,660 ft.

Jim Hogg County: Sam Cunningham and Rodney DeLange 2-A Silver Lakes Ranches, Inc., Sec. 7, Fowley & Rankin Subd., El Sordo Grant. Dry. TD 4,201 ft.

McMullen County: Deep Rock Oil Corp. 1-A Nueces, BS & F Sur. 173, A-513. Dry. TD 7,520 ft.

Nueces County: Theo Hamm Brewing Co. 1 Atkinson, Sec. 51, George H. Paul, Subd., Driscoll Ranch. Dry. TD 6,220 ft.

William F. Morgan 1 Nemec, Lot 3, Sec. 7, Bohemian Colony Lands Subd. Shut down 6,114 ft.

A. O. Phillips 1 Mumme, Tract 11, Share 8, Bluntzer Partition, Casa Blanca Grant, A-221. Dry. TD 6,000 ft.

R. M. Well Servicing & Drilling Co. and Anderson Brothers Corp. 1 J. R. Doughety estate, Share 7, Bluntzer Partition, Casas Blanca Grant. Dry. TD 6,000 ft.

Sun Oil Co. 1 Thiele, Sec. 133, F. Z. Bishop Subd., Driscoll Ranch, Santa Petronilla Grant. Dry. TD 8,799 ft.

San Patricio County: Spartan Drilling Co. 1 Granberry, Sec. 20, Coleman-Fulton Pasture, G. H. Paul Subd. Dry. TD 9,010 ft.

Kirkwood & Co. and Caroline Hunt Sands 1 Elliott, Blk. 14, Welder & Odemn Subd. IP 66 BOPD, 14/64-in., 33.3°, casing perforations 6,730-36 ft. TD 8,015 ft. (New pay in Spartan field.)

Webb County: Blanco Oil Co. 2 Villarreal et al, J. M. Garcia Sur. 700. Dry. TD 2,967 ft.

Campbell, Calohan & Rowden 5 Kirkpatrick, W. W. Griffin Sur. 26. IPP 58 BOPD, 36°, second upper Rosenberg sand 1,909-12 ft. (Casing perforations). TD 1,921 ft. (New pay in Tal Vez field.)

Don H. Marsh 1 Tex-Mex., Sur. 599. Dry. TD 1,010 ft.

O. Neathery, Jr., 1 Walker, Sur. 865. Dry. TD 6,056 ft.

Wilson County: A. W. Phillips 1 Lorenz, Morris Mays Sur. 37, A-204. IPP 33 BOPD, 27.2°, casing perforations 3,048-60 ft. TD 5,491 ft. (New field.)

Zapa County: V. G. Schimmel 1 Martiniana Garza et al, GC & SF Sur. 282. Dry. TD 2,530 ft.

TEXAS GULF COAST

Bee County: Fidelity Oil & Royalty Co. 1 Shivers, Lot 2, Sec. 104, G. H. Paul Subd., Welder Ranch. Dry. TD 5,460 ft.

Colorado County: Tennessee Production Co. 5 Glasscock, BBB & C Sur., A-114. IP 4,400 M.c.f. daily, open flow, Cockfield 5,133-35 ft. (casing perforations). TD 5,175 ft. (New pay in Glasscock field.)

Fayette County: Bankline Oil Co. 1 Gens et al, W. H. Toy Lge., A-105. Dry. TD 4,512 ft.

M. E. Robinson Oil Properties 1 Helmcamp et al, Jose Maria Molina ⅓ Lge., A-235. Shut down. TD 2,600 ft.

Harris County: J. C. Wynne and R. H. Hedge 1 Winkleman, Martin Moran Sur., A-580. Dry. TD 5,603 ft.

Jackson County: W. Earl Rowe 2 Regina Gayle estate, Nestor Clay Sur., A-13. Dry. TD 6,130 ft.

P. R. Rutherford 1 Germer et al, Blk. 2, E. L. Beaty Sur. 5, A-97 (East Cordele area). Dry. TD 5,302 ft.

Lloyd H. Smith, Inc., et al 1 Holloway, Lot 15, Robert Clement Subd., S. F. Austin Sur., A-5. Dry. TD 6,415 ft.

Karnes County: Harris S. Stahl 2 Lyssy, E½ Blk. 22, Cora Butler Subd., Bartlett Hickman Sur. Dry. TD 4,000 ft.

Liberty County: Petrex Oil Corp. 1 Boyt et al, GC & SF Sur. 15, A-455. Dry. TD 8,020 ft.

San Jacinto Petroleum Corp. 3 Whitley-Gulf, H. A. Nolan Sur. IP 209.89 BOPD, 12/64-in., 36.4°, casing perforations 4,016-42 ft. TD 4,085 ft. (New pay in North Dayton field.)

Warren Burdett, Inc., 1 Gibbs Brothers, J. D. Martinez Lge. 1, A-64. Dry. TD 7,512 ft.

Matagorda County: The Texas Co. 1 Hurlbut NCT-1, GC & SF 551, A-461. IP 794 M.c.f. daily, ⅛-in., casing perforations 8,747-76 ft. TD 9,000 ft. (New field.)

Montgomery County: W. E. Butler 1 Foster et al, William S. Allen Sur., A-2. Dry. TD 5,001 ft.

Refugio County: P. R. Rutherford 1 Fagan, Maty Byrne Sur. Dry. TD 7,380 ft.

Victoria County: Reynolds Metal Co. 1 Hall et al, P. Castillo Sur., A-17. Dry. TD 5,215 ft.

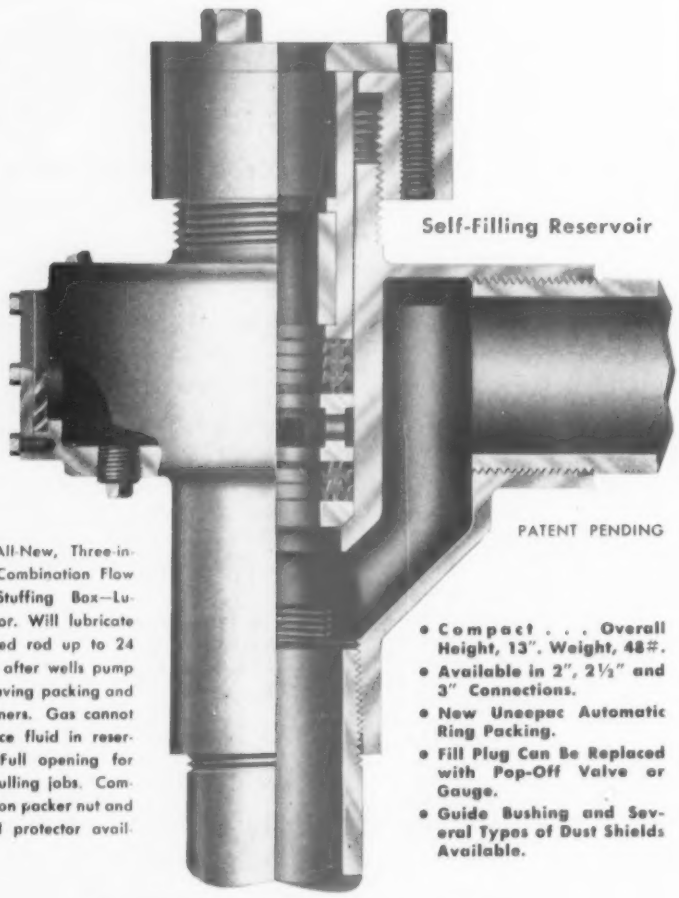
Wharton County: Kirkwood & Co. and Weaver & Sharp 1 Johnson et al, Sec. 16, Mack Weiss Sur., A-556. Dry. TD 6,650 ft.

EAST TEXAS

Harrison County: Robert Cargill 1 McKelvey-Dunn Unit, N. Lansing area, BBB&C Sur. Dry. TD 7,002 ft.

MIW

POLISHED ROD LUBRICATOR AND STUFFING BOX TYPE "B"



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- **Compact . . . Overall Height, 13". Weight, 48#.**
- **Available in 2", 2½" and 3" Connections.**
- **New Uneepac Automatic Ring Packing.**
- **Fill Plug Can Be Replaced with Pop-Off Valve or Gauge.**
- **Guide Bushing and Several Types of Dust Shields Available.**

Available Through Major Supply Stores

MUSKOGEE IRON WORKS, INC.

MUSKOGEE, OKLAHOMA

TEXAS PANHANDLE

Roberts County: Cabot, Morgan, Head and Sinclair 1-A Morrison, 12-C-C&M Sur., 9 miles NW Quinduno field. Dry. TD 7,217 ft. in granite wash.

Wheeler County: Gulf Oil Corp. 1-A Bailey, 20-A5-H&GN, 5 miles SE Mobeetie. Dry. TD 11,010 ft.

WEST CENTRAL TEXAS

Brown County: David Kane 1 O. N. Mayo, Blk. 21, Kerr CSL Sur. 278. IPP 50 BOPD, 42°, pay 1,520-42 ft. TD 1,565 ft.

J. J. Lynn 1 Dobbs, Sec. 2, SA&MG Sur. Dry. TD 1,403 ft.

Callahan County: Johnson & Warren 1-A Brown, I&GN Sur. Dry. TD 1,715 ft.

Coleman County: Coleman Producing Co. 4 Boggus, M. Martinez Sur. 751. Dry. TD 1,785 ft.

Creslenn Oil Co. 1 A. E. Herring, R. A. Spears Sur. 150. IP 258 BOPD, 24/64-in., 41°, King sand 2,031-41 ft. TD 3,700 ft.

J. J. Lynn 1 McClatchey, Sec. 90, McKinney & Williams S ur. Dry. TD 1,090 ft.

J. J. Lynn 2 McCormick, Caldwell CSL Sur. 249. Dry. TD 1,158 ft.

J. J. Lynn 5 McCormick, Caldwell CSL Sur. 249. Dry. TD 1,382 ft.

J. J. Lynn 7 McCormick, Caldwell CSL Sur. 249. Dry. TD 1,136 ft.

Warren D. Sorrells 1 W. J. Stevens, 54-2-GH&H. Dry. TD 3,510 ft.

Harry Todd 1 O. E. Beck, 132-1-GH&H. IP 732 BOPD, 28/64-in., 42°, Morris sand 2,792 ft. TD 2,809 ft.

Westates Petroleum Corp. of Texas 1 Victoria Snall, 15-2-T&NO. Dry. TD 3,650 ft.

Eastland County: J. E. Connally 1 Susie P. Wharton, Harvey Kendrick Sur., A-340. IPP 94 BOPD, 41°, Marble Falls 3,024-32 ft. TD 3,335 ft.

Fisher County: Allison & Prestridge 1 W. J. Harvey, 3-20-T&P. Dry. TD 6,426 ft. Elev. 2,019 ft., Ellenburger 5,930 ft., Cambrian 6,322 ft.

Haskell County: Thos. D. Humphrey & Sons 2-C Collins, Sec. 159, H. Fisher Sur. Dry. TD 3,926 ft.

Thos. D. Humphrey 7-A Rike, R. G. Cummings Sur., A-108. Dry. TD 5,335 ft.

E. R. Perkins 1-A Hokanson, Sec. 10, J. B. Shaw Sur., A-988. Dry. TD 4,710 ft.

Jones County: Blackwell Oil & Gas Co. 1 Williams, W. M. Delk Sur. 241. Dry. TD 4,309 ft.

Grisham-Hunter Corp. 1 J. W. Poer, McMullen & McGloin Sur. 337. Dry. TD 3,217 ft.

Jones & Stasney 1 Morgan Williams, Sec. 5, D&DA Sur. Dry. TD 3,710 ft.

J. J. Lynn 1 Omar Burleson, Sec. 50, D&DA Sur. Dry. TD 4,185 ft.

J. J. Lynn 2 Ekdahl, 18-3-H&TC. Dry. TD 4,570 ft.

Sojourner Drilling Co. 1 Harrison, 5-4-H&TC. Dry. TD 2,301 ft.

Stonewall County: Southern Minerals Corp. 1 Ella Pumphrey, E. Chandler Sur., A-60. Dry. TD 6,545 ft. Elev. 1,653 ft., Ellenburger 6,227 ft., Cambrian 6,496 ft.

NORTH TEXAS

Archer County: L. T. Burns 1 Conrady, Blk. 4, Clark & Plumb. Dry. TD 5,412 ft.

L. T. Burns 47 McGregor estate, 10-A1010-H&TC. IPP 75 BOPD, 42°, Strawn pay 4,807 ft. TD 4,816 ft.

Olin Calvin 4 Griffith, BBB&C Sur. 7, A-48. Dry. TD 1,239 ft.

White Eagle Oil Co. 1 Sebring, 16-4-H&TC. Dry. TD 5,513 ft.

Baylor County: Bridwell Oil Co. 1-A Wirz, Sec. 162, T&NO. Dry. TD 5,100 ft.

Clay County: Elmer Frerck 1 Landrum, Blk. 5, Parker CSL. Dry. TD 695 ft.

Gray & Metcalf 1-A Stine, Blk. 64, Bacon Subd. IPP 39 BOPD, 39°, pay 873 ft. TD 882 ft.

Cooke County: Virgil Taylor 1 Fields & Bowers, C. F. Stanley Sur., A-904. Dry. TD 1,793 ft.

Jack County: Delfern Oil Co. 1 Mary Hoefle, J. W. Barrett Sur., A-48. IPP 36 BOPD, 41°, Strawn sand 3,660 ft. TD 3,666 ft.

Luke Grace Drilling Co. 1 Emma McClure, P. Osborn Sur., A-543. Dry. TD 5,582 ft.

G. E. Kadane & Sons 1 Ada L. Woods, A. Ferguson Sur., A-215. IPP 65 BOPD, 40°, conglomerate pay 5,112-16 ft. TD 5,185 ft.

Rankin & Pitcock 1-B Glenn, E. B. Compton Sur., A-2185. Dry. TD 6,609 ft.

Knox County: Benedum-Trees Oil Co. 1 Big Four Ranch, 32-4-D&W. Dry. TD 7,182 ft. Elev. 1,646 ft., Caddo 5,922 ft., Mississippian 6,209 ft., Ellenburger 6,681 ft., Hickory 6,948 ft., pre-Cambrian 7,172 ft.

Montague County: Arnold H. Bruner 1 Annie Howard, F. Robertson Sur., A-620. Dry. TD 2,804 ft.

Wichita County: I. Dee Campbell 1-A Goetze, Blk. 1, SA&MG Sur., A-269. Dry. TD 1,811 ft.

I. Dee Campbell 1-C Waggoner, M. A. Willis Sur., A-547. Dry. TD 1,638 ft.

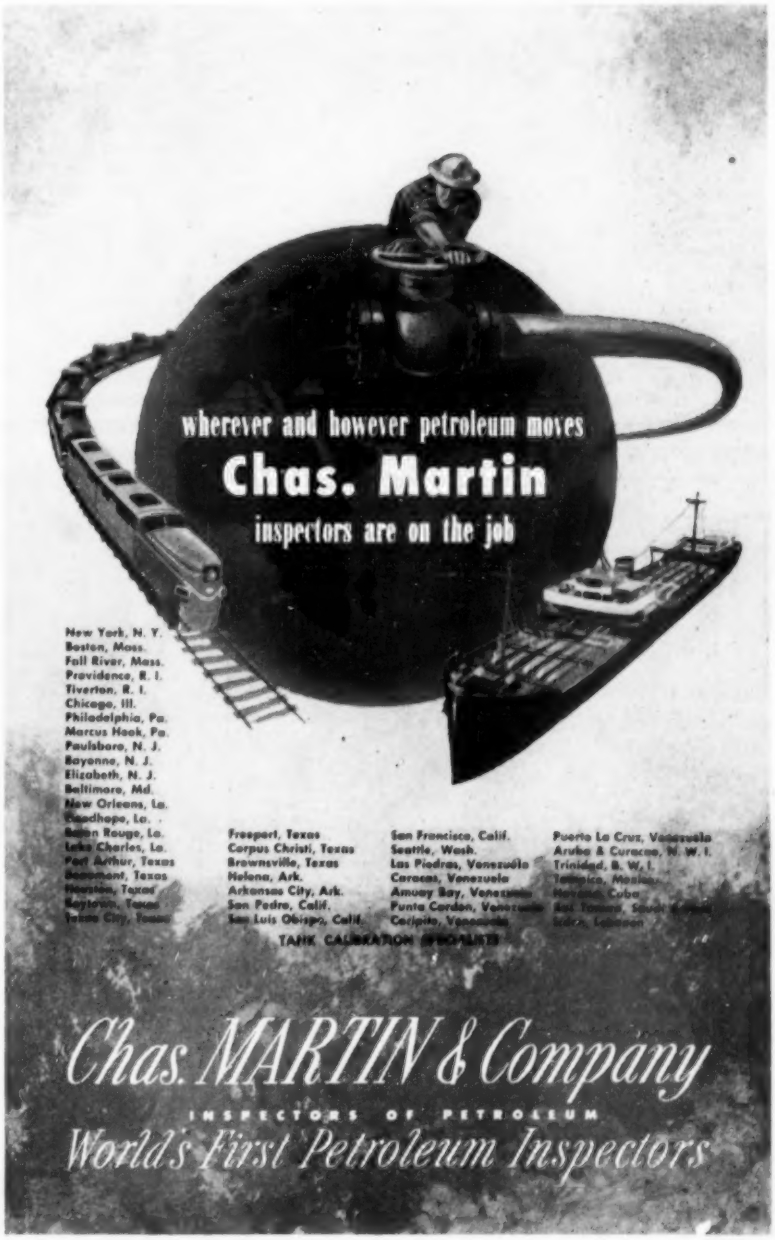
Wilbarger County: G. M. Shanor 1 Karl Guggisberg, W. A. McKinney Sur., A-1768. Dry. TD 2,288 ft.

Young County: Akin & Dimock 1 Harris Wilson, TE&L Sur. 67, A-343. Dry. TD 5,112 ft.

D D Drilling Co. 1 Pringle, Blk. 217, TE&L Sur., A-464. Dry. TD 950 ft.

J. W. Hastings 1 The Allar Co., D. P.

WILDCAT COMPLETIONS



WILDCAT COMPLETIONS

Sharp Sur., A-1854. Dry. TD 3,545 ft.
Pontiac Drilling Co. 1 Heard, Blk. 407, TE&L Sur., A-614. Dry. TD 5,225 ft.
Rankin & Pitcock 7 Scott, Jacob Garrett Sur., A-108. IP 110 BOPD, 18/64-in., 42°, Caddo pay 3,496 ft. TD 4,391 ft.

SOUTHEAST NEW MEXICO

Eddy County: D. B. Scully 1 Superior-State, 32-25s-29. Dry. TD 3,084 ft. Elev. 3,012 ft., Delaware lime 2,890 ft., sand 2,924 ft.
Lea County: Blackwood & Nichols 1 Carter, 5-18s-39e. IPP 12 BOPD, pay 5,822 ft. TD 6,628 ft.
Humble Oil & Refining Co. 1-AC State, 22-17s-35e. Dry. TD 13,871 ft. Elev. estimated 3,941 ft., Devonian 13,521 ft.
Magnolia Petroleum Co. 1 B. E. Shipp, 22-16s-37e. Dry. TD 12,540 ft. Elev. 3,797 ft., Wolfcamp 9,830 ft.

WEST TEXAS

Coke County: Humble Oil & Refining Co. 1 Georgia McCutchen, N. Eastland Sur. 329. Dry. TD 5,903 ft. Ellenburger 5,440 ft., Cambrian sand 5,876 ft.
J. Kirk Johnson 1 Nora Gee, 120-2-H&TC. Dry. TD 7,110 ft. Elev. 2,371 ft., Strawn sand 6,640 ft.
Plymouth Oil Co. 1 R. E. Hickman, S. A. Maverick Sur. 960. Dry. TD 6,124 ft.
Crockett County: John L. and P. D. Moore 1 Shannon estate, 10-10-GC&SF. IP 38.6 BOPD, ½-in., 30°, San Andres 1,838 ft. TD 1,842 ft.
Kent County: Thomas Bomar 1 W. A. Mays, 45-4-H&GN. Dry. TD 1,797 ft.
King County: Lawson Drilling Co. 1 Starr Pope, Sec. 199, I&GN. Dry. TD 6,350 ft. Elev. 1,966 ft., Cisco 3,654 ft., Canyon 4,700 ft. reef 4,816 ft.
Martin County: W. H. Black 1 M. F. King, 32-40-T1N-T&P. Dry. TD 5,513 ft.
Midland County: R. P. Coats 1 R. L. Porter, 23-40-T1S-T&P. Dry. TD 5,071 ft.
C. E. Marsh 1-A Barron, 24-40-T1S-T&P. Dry. TD 5,010 ft.
O'Neal Drilling Co. 1 Walter Anguish, 8-X-H. P. Hilliard Sur. Dry. TD 5,513 ft.
Fred Turner Jr. 1 Whatford, 18-39-T1S-T&P. Dry. TD 5,016 ft.
Pecos County: H. L. Hunt 1 R. L. Harris, 26-3-H&TC. IP 5,000 M.f.g., plus 204 BOPD, 53°, Devonian pay 5,448 ft. TD 5,476 ft.
Runnels County: American Trading & Production Co. 1 McShan, R. M. Williamson Sur. 233. Dry. TD 4,584 ft.
Burt Oil Co. 1 Schwartz, Sec. 325, B. E. Adams Sur. Dry. TD 4,284 ft.
C. C. Chandler 1 Jack Ashton, E. S. Mitchison Sur. Dry. TD 2,705 ft.
J. W. King Jr. 1 Early, Columbus TAT Sur. 65. Dry. TD 2,614 ft.
Schleicher County: C. L. Reasor 1 B. M. Boyd, 19-8-TW&NG. Dry. TD 5,603 ft., elev. 2,290 ft., Ellenburger 5,273 ft.
Sutton County: A. A. Cameron 1 Alswell, Sec. 14, Blk. GSD, W. J. Young Sur. Drg. TD 7,065 ft.
Terry County: A. G. Slocum 1 Haybeck, 34-B11-C&MRR. Dry. TD 6,101 ft.
Tom Green County: Ted Grobel and Frank Costanza 1 L. Krist, Oswald Hoyer Sur. 217. Dry. TD 927 ft.
Richardson Oils, Inc. 1 Schwartz, J. Cherry Sur. 155½, 4 miles E San Angelo. Dry. TD 7,168 ft. Elev. 1,849 ft., Ellenburger 5,810 ft., Wilburns 6,035 ft., Hickory 6,420 ft., pre-Cambrian granite 7,141 ft.

ILLINOIS

Clark County: R. Hurst 1 Daniel, NW SE NE 7-9n-14w. Dry. TD 1,568 ft.
T. E. Hults 1 Grumin-Snavely, NW NE NE 25-9n-13w. Dry. TD 923 ft.
M. Smith 1 Ryan, SE NW SE 35-11n-14w. Dry. TD 414 ft.
Clay County: Calvert Drilling Co. 1 McAllister, SW SW NW 3-2n-7e. Dry. TD 2,744 ft.
Clinton County: R. H. Robben 1 Breeze-Trenton Mining Co., NW NW NW 22-2n-3w. Dry. TD 2,641 ft.
Crawford County: E. F. Atkins and E. O. Hale 1-A Goodwin, SE NW NW 22-6n-11w. Dry. TD 1,006 ft.
Hamilton County: Kewanee Oil Co. 1 Leach, NE NE SW 31-3s-7e. Dry. TD 3,453 ft.
Macoupin County: H. E. Livermore 1 Meyer, SE SE NE 34-7n-7w. Dry. TD 525 ft.
Livermore 1 Hirschl, SW SW NW 34-7n-7w. Dry. TD 500 ft.

INDIANA

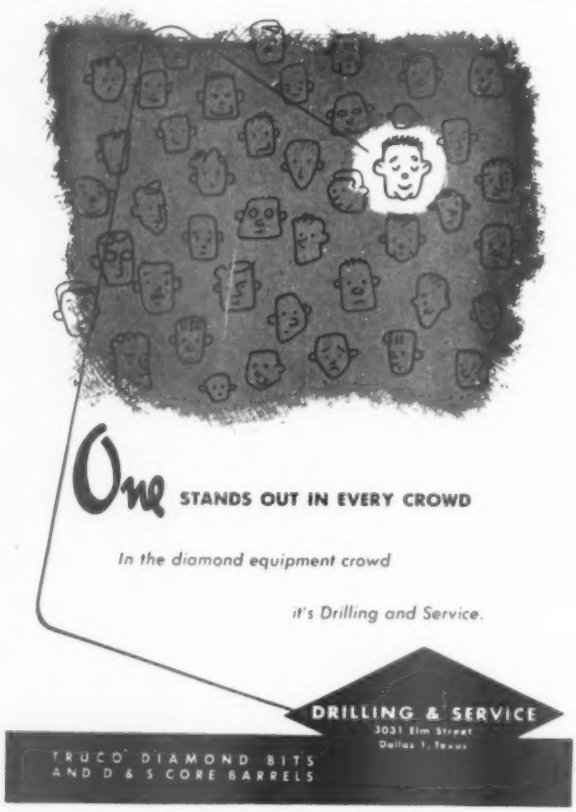
Dubois County: Walter Sargent 1 Wendeholt, NW NW NW 30-3s-4w. Dry. TD 1,005 ft.
Posey County: Don Slape 1 DeFur, SE SE SE 24-5s-13w. Dry. TD 2,926 ft.
Spencer County: Indiana American Oil Co. 1 Hendrickson, SE SE NE 14-6s-5w. Dry. TD 670 ft.
E. Walter 1 Wagoner, SW SW NW 36-6s-6w. Dry. TD 1,938 ft.
Sullivan County: Great Lakes Carbon Co. 1 Roberts, NE NW SE 5-9n-8w. Dry. TD 1,156 ft.
Vanderburgh County: C. E. O'Neal 1 Rexing, SE NW NE 32-4s-11w. Dry. TD 2,628 ft.
Warrick County: Mulzer Bros. 1 Wedeking, SW SW SW 14-4s-6w. Dry. TD 1,350 ft.
Great Lakes Carbon Co. 1 Wilson, SW SW SE 15-7s-8w. Dry. TD 1,911 ft.

KENTUCKY

Logan County: Paul McGinley 1 Eddings,
(Continued on page 456)

THE OIL AND GAS JOURNAL

"How stupid of me, gentlemen, I've sat here all evening without my ear phone hooked up."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President, Ford Motor Company

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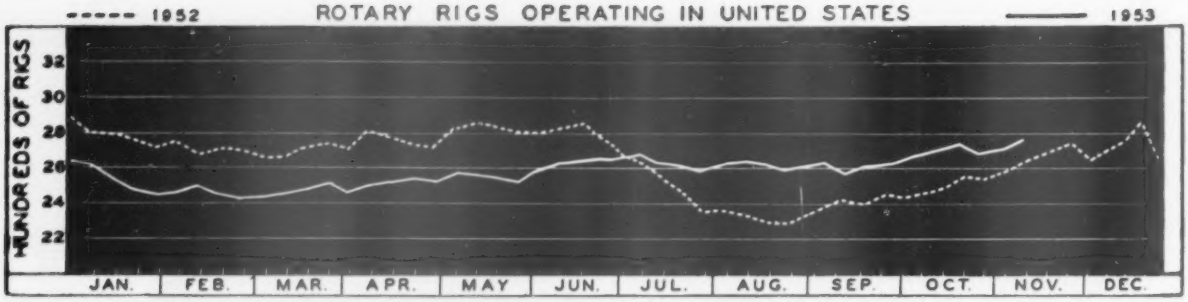
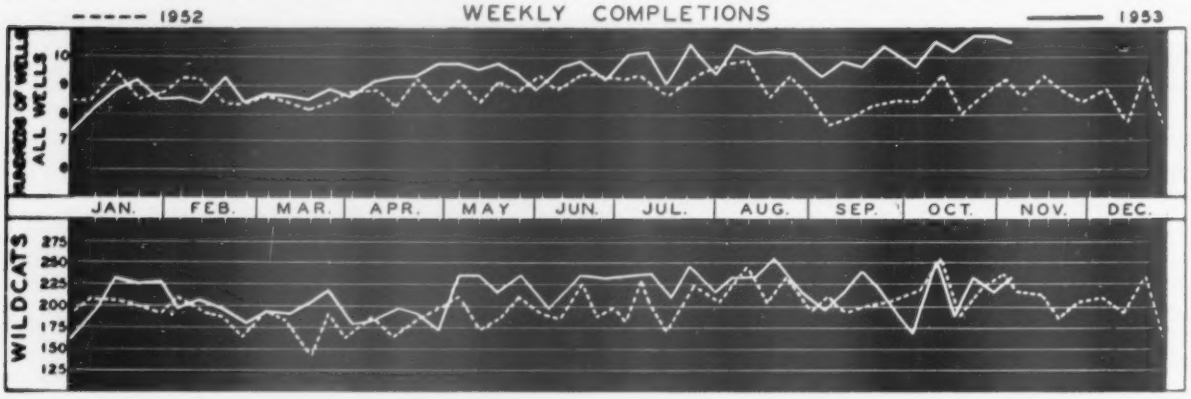




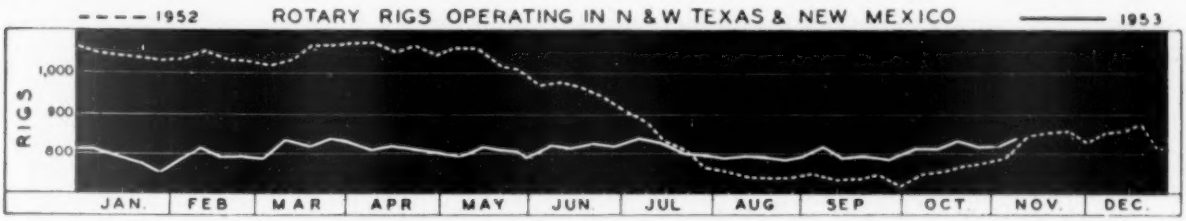
CURRENT STATISTICS

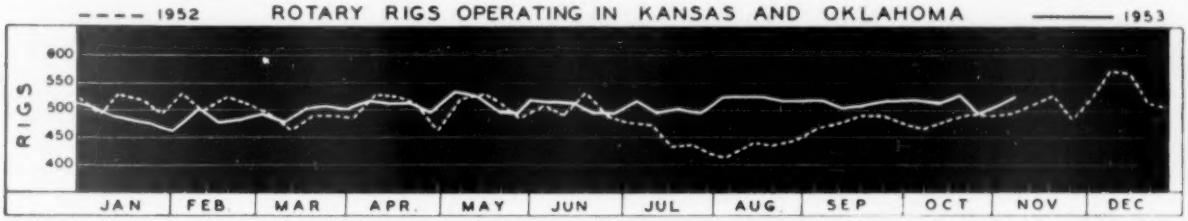
EXPLORATION

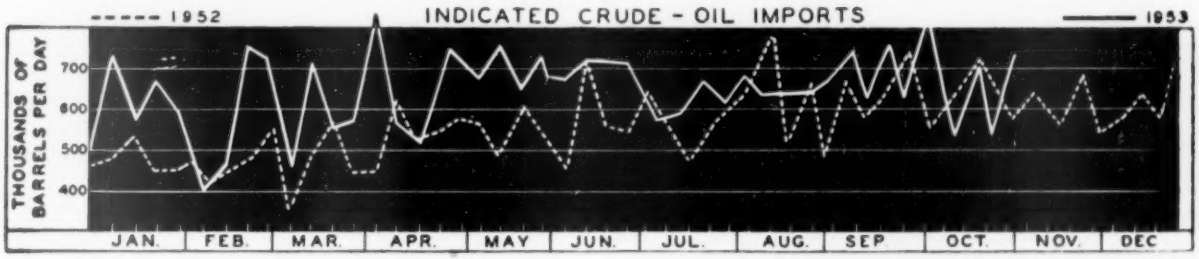
WEEKLY WELL COMPLETIONS . . . WEEK ENDED NOVEMBER 7, 1953

	Total of all wells					Nov. 7		Wildcat completions and discoveries					Cumulative total, 1953				
	Comp.	Oil	Gas	Dry	Footage	1953	1952	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
New York	16	8	0	*8	23,500	651	666	0	0	0	0	0	0	0	0	0	0
Pennsylvania	40	21	2	†17	67,750	1,629	1,634	0	0	0	0	0	0	0	3	12	15
West Virginia	10	1	8	1	29,698	536	509	0	0	1	1	2	0	0	11	7	18
Ohio	22	8	4	‡10	49,201	901	902	0	0	0	0	0	2	0	3	13	18
Indiana	20	3	0	17	30,808	1,106	1,088	0	0	0	8	8	12	0	2	307	321
Kentucky	24	8	6	10	47,765	972	1,125	0	0	0	3	3	8	0	1	164	173
Illinois	49	18	0	31	117,795	1,739	1,819	0	0	0	9	9	5	0	0	356	361
Michigan	15	8	1	6	25,646	527	606	0	0	0	3	3	15	0	5	218	238
Kansas	75	22	4	49	243,066	4,130	3,873	0	0	0	19	19	78	0	31	657	766
Nebraska	8	0	0	8	39,036	276	252	0	0	0	5	5	16	0	5	116	137
Oklahoma	120	62	6	§52	389,442	6,378	4,937	2	0	0	11	13	104	6	28	525	663
Texas	363	210	13	140	1,615,756	14,636	14,849	17	0	3	91	111	741	52	152	3,602	4,547
North Central (Dist. 7-B & 9)	146	80	0	66	471,279	5,555	4,834	10	0	0	37	47	386	0	16	1,442	1,844
West (Dist. 7-C & 8)	77	54	0	23	397,571	3,166	4,462	2	0	0	19	21	157	2	13	582	754
Panhandle (Dist. 10)	19	14	2	3	77,757	659	554	0	0	0	2	2	0	2	0	18	20
Eastern (Dist. 5 & 6)	11	8	0	3	62,673	683	694	0	0	0	1	1	20	2	5	223	250
Gulf Coast (Dist. 2 & 3)	55	23	8	24	340,340	2,142	2,226	1	0	2	14	17	90	21	64	580	755
Southwest (Dist. 1 & 4)	55	31	3	21	266,136	2,431	2,079	4	0	1	18	23	88	25	54	757	924
Louisiana	90	53	13	24	515,299	2,358	1,997	3	1	1	5	10	71	31	20	315	437
Northern	49	30	9	10	128,653	1,029	1,084	1	0	0	4	5	10	2	2	131	145
Southern	41	23	4	14	386,646	1,329	913	2	1	1	1	5	61	29	18	184	292
Arkansas	13	4	0	9	63,211	469	351	0	0	0	4	4	12	0	0	112	124
Mississippi	13	7	1	5	80,636	335	298	0	0	1	3	4	17	1	5	145	168
Southeastern States	3	0	0	3	13,906	125	66	0	0	0	3	3	1	0	0	102	103
Montana	27	9	6	12	79,446	376	275	0	0	0	7	7	12	0	0	95	107
Wyoming	12	8	0	4	80,598	682	573	0	0	0	2	2	22	0	3	117	142
Colorado	22	14	0	8	120,663	602	384	1	0	0	7	8	25	0	11	263	299
Utah	1	0	1	0	4,489	60	71	0	0	0	0	0	3	0	4	31	38
New Mexico	36	12	17	7	207,305	1,211	881	1	0	0	3	4	21	1	14	109	145
California	64	51	0	13	291,021	2,198	2,070	3	0	0	11	14	59	0	11	485	555
North Dakota	7	4	0	3	42,913	227	91	0	0	0	3	3	9	0	0	60	69
Miscellaneous (S. D.)	1	0	0	1	5,822	70	123	0	0	0	1	1	1	0	4	42	47
Total United States	1,051	531	82	438	4,184,792	42,194	39,440	27	1	6	199	233	1,234	91	313	7,853	9,491
Total previous week	1,075	598	65	412	4,288,552	....	....	25	1	4	187	217	1,207	90	307	7,654	9,258
Total November 8, 1952	879	410	63	406	3,429,220	....	....	26	1	4	186	217	1,191	70	216	7,442	8,919

Service wells included: *8, †15, ‡1, §3.



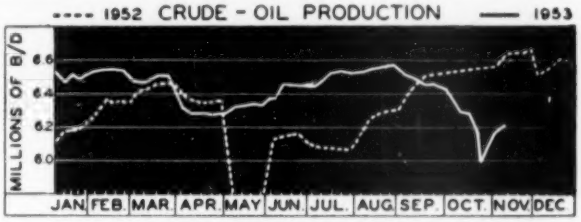


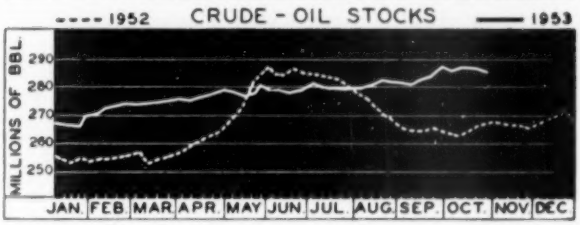


DAILY AVERAGE PRODUCTION FOR WEEK

	November 7 — Crude oil	Lease condensate	Total	Oct. 31 total
Alabama	4,600		4,600	4,600
Arkansas	74,050	450	74,500	75,750
California	1,000,200		1,000,200	996,700
Colorado	105,100		105,100	105,400
Eastern	59,000		59,000	60,000
Florida	1,500		1,500	1,550
Illinois	166,100		166,100	167,600
Indiana	34,600		34,600	34,700
Kansas	298,000		298,000	230,000
Kentucky	32,600		32,600	32,500
Louisiana	640,950	38,100	679,050	630,850
North	100,450	3,100	103,550	101,500
South	540,500	35,000	575,500	529,350
Michigan	32,300		32,300	33,200
Mississippi	87,200	3,100	90,300	89,150
Montana	32,700		32,700	31,600
Nebraska	12,200		12,200	12,500
New Mexico	205,000	750	205,750	204,425
Oklahoma	514,200		514,200	509,800
Texas	2,590,200	47,225	2,637,425	2,738,375
Dist. 1	38,300	400	38,700	38,925
Dist. 2	137,075	6,000	143,075	150,725
Dist. 3	418,200	23,800	442,000	458,750
Dist. 4	241,350	5,900	247,250	260,075
Dist. 5	45,200	450	45,650	47,900
Dist. 6	115,250	5,100	120,350	127,875
East Texas field	239,000		239,000	244,500
Dist. 7-B	118,000	50	118,050	118,000
Dist. 7-C	155,525	4,125	159,650	167,400
Dist. 8	821,375	1,000	822,375	863,125
Dist. 9	184,425	350	184,775	185,675
Dist. 10	76,500	50	76,550	75,425
Utah	4,500		4,500	4,800
Wyoming	209,700		209,700	209,100
North Dakota	14,200		14,200	13,700
Total U. S.	6,118,900	89,625	6,208,525	6,186,300
Change from previous week,			up 22,225	
Canada	189,900		189,900	254,750
Total U. S. production January 1-November 7			2,016,665,300 bbl.	
Same period last year (crude plus cond.)			*1,937,166,975 bbl.	

*Includes 26,286,785 bbl. condensate.



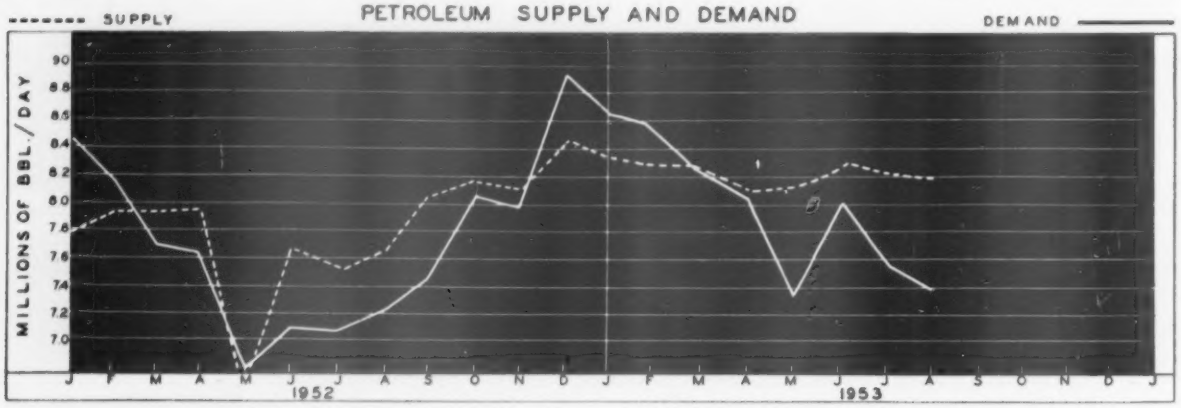


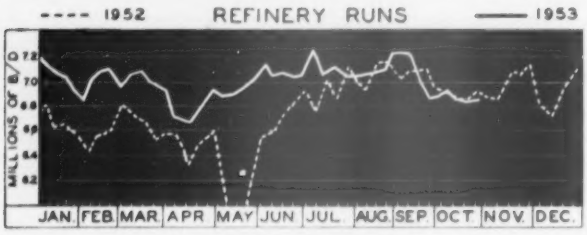
CRUDE-OIL STOCKS BY STATES OF ORIGIN*

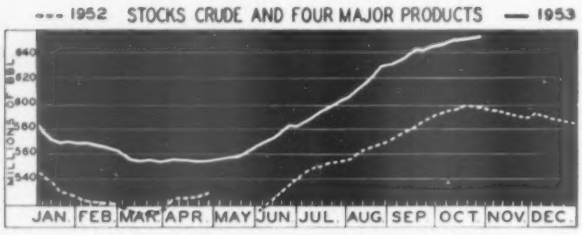
(Thousands of barrels)

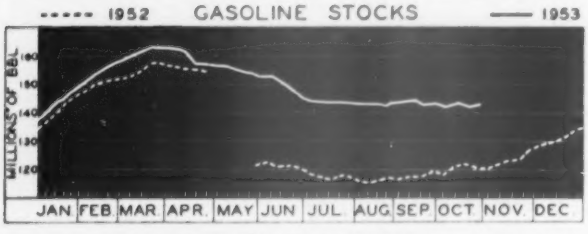
	Oct. 31, '53	Oct. 24, '53	Nov. 1, '52
Pennsylvania Grade	2,911	2,944	2,198
Other Appalachian	1,853	2,066	1,984
Illinois, Indiana, Michigan	13,029	12,628	12,220
Arkansas	3,420	3,344	2,918
Louisiana	17,060	17,228	16,162
North	3,199	3,207	2,567
Gulf	13,861	14,021	13,595
Mississippi	3,604	3,598	2,993
New Mexico	8,997	9,271	7,578
Oklahoma and Kansas	39,750	40,962	37,866
Texas	134,734	134,719	129,891
East Texas	12,350	12,152	12,393
West Texas	60,180	60,017	59,040
Texas Gulf	29,436	29,390	26,186
Other Texas	32,768	33,160	32,272
Rocky Mountain	16,996	16,599	15,120
California	32,654	33,112	31,594
Foreign	11,393	10,446	8,011
Total	286,401	286,917	268,535

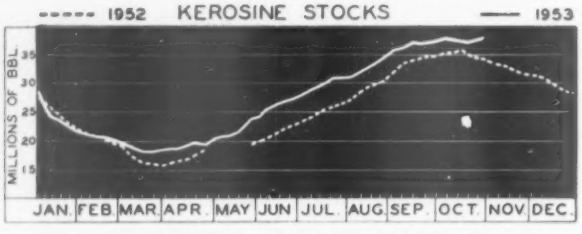
*Bureau of Mines. †Includes 3,172,000 bbl. in California.

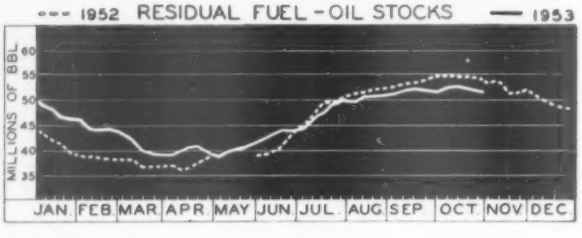












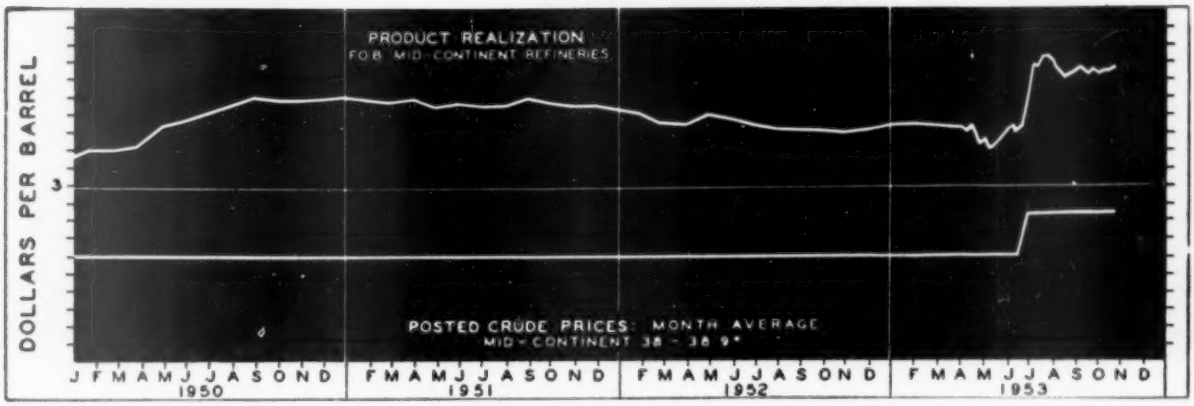
(A.P.I. Report for November 7 Delayed on Account of Armistice Day Holiday)

A.P.I. REFINERY REPORT, OCTOBER 31

(Thousands of barrels)

District—	Daily avg. runs	Daily average production—Gaso.*	Kero.	Dist.	Resid.	Stocks‡—Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, October 1952—Daily avg. runs	Daily average production—Gaso.*	Kero.	Dist.	Resid.
East Coast	986	411.4	33.7	247.9	185.1	33,754	15,570	49,596	12,252	1,045	422.7	44.7	254.9	219.6
Appalachian:														
District 1	102	37.3	6.6	17.1	11.7	3,864	631	1,740	815	97	40.8	5.9	17.2	13.9
District 2	91	47.6	4.0	15.6	12.6	1,681	669	731	136	87	40.7	6.7	13.1	13.9
Ind., Ill., Ky.	1,243	684.6	90.3	211.6	172.6	27,170	9,644	24,726	4,655	1,244	674.6	73.6	220.5	159.0
Okla., Kans., Mo.	553	330.8	17.9	122.1	46.4	14,207	2,318	12,922	1,313	565	324.9	11.4	136.6	58.0
Inland Texas	250	182.9	11.7	45.7	31.1	6,055	617	2,537	1,413	265	180.0	12.8	41.4	36.9
Texas Gulf Coast	1,641	798.4	135.3	405.0	232.6	20,401	4,492	16,753	7,006	1,746	780.6	117.5	450.3	268.6
La. Gulf Coast	561	277.6	68.7	123.0	38.4	8,028	2,692	7,305	1,412	525	269.2	61.1	131.0	54.8
N. La. and Ark.	88	38.7	6.1	17.6	6.3	3,253	669	862	148	85	34.4	7.6	21.5	7.0
Rocky Mountain:														
New Mexico	19	12.6		3.0	3.9	164		58	31	18	11.2	0.7	2.9	4.1
Other Rocky Mtn.	217	107.7	2.4	51.6	37.0	4,593	261	2,810	974	205	99.2	5.1	39.4	39.6
California	1,116	458.0	12.0	193.1	363.9	20,198	400	14,591	21,403	1,001	422.5	5.1	173.7	328.5
Oct. 31, 1953	6,867	3,387.6	388.7	1,453.3	1,141.6	143,368	37,963	134,631	51,558	6,883	3,300.8	352.2	1,457.5	1,203.9
Oct. 24, 1953	6,830	3,373.6	325.3	1,414.3	1,166.1	142,666	37,394	132,767	52,633					
Nov. 1, 1952	6,892	3,383.9	369.6	1,415.3	1,217.9	120,563	33,760	120,267	53,292					

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipe lines.


PRODUCT REALIZATION
F.O.B. MID-CONTINENT REFINERIES
DOLLARS PER BARREL
3
POSTED CRUDE PRICES: MONTH AVERAGE
MID-CONTINENT 38 - 38.9°
J F M A M J J A S O N D
1950
F M A M J J A S O N D
1951
F M A M J J A S O N D
1952
F M A M J J A S O N D
1953

In this trend chart refinery realization is based on average Mid-Continent grade crude oil (not 38° gravity only) and average prices for refinery products as published in The Oil and Gas Journal basis Oklahoma (Group 3). Refinery yields confined to gasoline, kerosine, distillate and fuel oil. Realization averaged $3.69 for week ended October 31, $3.66 for previous week, and $3.33 for October 1952. The above trend information is based on volumes and current prices and therefore does not reflect changes in operating costs.

REPRESENTATIVE QUOTATIONS

Representative spot-market quotations of leading suppliers as of November 11, 1953. Figures are f.o.b. plant for tank-car shipments in cents per gallon, except for residual fuel oil which shows the price per barrel and wax, in cents per pound.

GASOLINE, KEROSINE, AND FUEL OILS

	Mid-Continent Group 3	New York Harbor (barge)	Texas Gulf Coast
Regular gasoline	11.125-11.625	12.75-13.8	11-11.75
Premium gasoline	12.125-12.625	14.25-14.8	12-12.75
42-44 w.w. kerosine	8.875-9.25	10.4-10.9	9-9.5
No. 2 straw fuel oil	7.875-8.25	9.4-9.9	8.25-8.5
No. 6 residual	$1.35-1.40	$2.25-2.40	$1.85-1.90

NATURAL GASOLINE

	Group 3	North Texas	N. La.
Grade 26-70	5.5	5.0	5.25
Grade 18-55	6.6	6.10	6.35

LUBRICATING OILS

South Texas

200 vis., No. 2-3 neutral	13.75
750 vis., No. 3-4 neutral	16.75
2,000 No. 5-6 neutral	18-18.75

LUBRICATING OILS

Mid-Continent

150-160 vis., D bright stock, 0-10 pp.	20.5-21.5
200 vis., No. 3 neutral, 0-10 pp.	14.5

Western Pennsylvania

145-155 vis., 10 p.t. bright stock	21.5
180 vis., 10 p.t. neutral	25.5

WAX

Mid-Continent

132-134 A.M.P.	6.0

REDUCTIONS in posted prices for tank-wagon deliveries of gasoline in the upper half of the East Coast district reflect the trend toward softer gasoline prices that has existed since last summer. Regular-grade motor fuel has been hard to move on the Gulf Coast for several months, and material has been available at prices well under the formal quotations for the area. The increasing number of price wars in the northeastern states was further indication of a weak market on the East Coast.

Socony-Vacuum Oil Co., Inc., announced a reduction in wholesale prices of regular-grade gasoline for the company's eastern marketing territory, effective November 6. The cut averaged a little more than 0.25 cent a gallon. Most of the marketers in the area have met the reduction.

The announced price changes were for regular-grade gasoline. The lower grades have been under more market pressure than premium, but current reports indicate that the better grades are off about 0.25 cent a gallon on the Gulf Coast spot market. The excess of premium on the Gulf Coast has tended to make more of this grade available on the New York spot market.

The cut in tank-wagon prices probably was delayed for at least a month by higher demands resulting from good motoring weather and by reduced refinery operations since about the middle of September.

Refinery runs for the 7-week period ended October 31 averaged about 3.4 per cent less than for the preceding 7-week period. Since refinery production of gasoline was off only 3.5 per cent, no big reduction in gasoline from a barrel of crude was indicated. Many suppliers believe that percentage yields of gasoline will have to be reduced by more than the normal seasonal adjustment if sharp price cuts are to be avoided this winter and early next spring.

CRUDE PRICES GRAVITY SCHEDULE

	Signal Hill, Calif.*	Oklahoma, Kansas	Gulf Coast Tex.†	West Tex ‡
14-14.9	$1.87			
15-15.9	1.93			
16-16.9	1.99			
17-17.9	2.05			
18-18.9	2.11			
19-19.9	2.18			
20-20.9	2.24	$2.50		$2.37
21-21.9	2.30	2.52		2.39
22-22.9	2.37	2.54		2.41
23-23.9	2.45	2.56		2.43
24-24.9	2.53	2.58	$2.91	2.45
25-25.9	2.61	2.60	2.93	2.47
26-26.9	2.69	2.62	2.95	2.49
27-27.9	2.76	2.64	2.97	2.51
28-28.9	2.83	2.66	2.99	2.53
29-29.9	2.91	2.68	3.01	2.55
30-30.9	2.97	2.70	3.03	2.57
31-31.9	3.04	2.72	3.05	2.59
32-32.9	3.12	2.74	3.07	2.61
33-33.9		2.76	3.09	2.63
34-34.9		2.78	3.11	2.65
35-35.9		2.80	3.13	2.67
36-36.9		2.82	3.15	2.69
37-37.9		2.84	3.17	2.71
38-38.9		2.86	3.19	2.73
39-39.9		2.88	3.21	2.75
40 and above		2.90	3.23	2.77

*Standard Oil Co. of California. †Upper Texas Gulf Coast. ‡Includes New Mexico Permian.

Prices East of California effective June 15, 1953. California prices effective February 16, 1953. Pennsylvania Grade prices effective September 21, 1953.

FLAT CRUDE PRICES

Representative posted schedules per barrel.

Louisiana:	
Cotton Valley (distillate)	$3.00
Cotton Valley (Holloway crude)	2.95
Texas:	
East Texas	2.90
Chapel Hill	2.83
Conroe	3.13
Van	2.73
Pennsylvania Grade:	
Bradford	4.05
Southwest Pennsylvania	3.61
West Virginia	3.55
Ohio	3.54
Illinois Basin	3.02

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EQUIPMENT FOR SALE

N-80 TUBING
11,000 ft. of new 2⅛ inch upset N-80 Jones & Laughlin Integral-joint. Pete Thomas. Phone 4-6455 or 6-8075, 1408 Philtower, Tulsa, Oklahoma.

FOR SALE: 1947 Fairchild, Model 24, five seats, radio, a good plane for aerial survey and patrol. For information write Box G-777, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE: 30,000' of 3½" O.D. 9.20# 10-Rnd. Thd. Range 2 #1 Used Seamless Oil Well Tubing, just pulled from gas wells. 75% of this material still has the stencils visible. We will load on cars F.O.B. Canton, Ohio, at .78c per foot. SERVICE PIPE & SUPPLY CO., INC., 2800 West Tusc., Canton, Ohio. Phone No. 2-1332.

SALES and rentals of cable drilling and fishing tools, casing and equipment, from the Southwest's largest stock of used cable tools and oil field supplies. Degen Pipe and Supply Co., Tulsa, Oklahoma.

FOR SALE: 5—Shriver 42"x42" cast iron Filter Presses, Plate & Frame Type, 27, and 54 chambers 1" cake; 15—Sperry 18"x18" cast iron Filter Presses, 11 chambers; #12 Sweetland Filter for 72 monel covered leaves on 2" centers. Immediate shipment. Attractively priced. Consolidated Products Co., Inc., 17-20 Park Row, New York 38, N. Y. BArclay 7-0600.

Stop Tong Breakage!
ARMITE DRILL COLLAR AND TOOL JOINT COMPOUND
ARMITE LABS.,
6609 Broad St., Los Angeles 1, Calif.
Petro. Industries Consultants,
C. A. Caracas, Venez.

Bargain Sale

Complete Ajax Engines

5—Ajax 10½" x 13", Type CMBG, Horizontal Single Cylinder, Two-Cycle Gas Engines, complete with all standard equipment, including horizontal shifting mechanism, less sheave and foundation bolts.

$2,000 each—f.o.b. Tulsa, Oklahoma

Bethlehem Supply Company
Box 2171 **Tulsa, Oklahoma**
Phone 5-9261—Ext. 343

FOR SALE

25,000—6⅝" OD. Seamless, 18.97#, Range 2, beveled, clean inside and out.
50,000—3½" OD, T&C, Electric weld and Seamless, NEW, 6.50#
40,000—4½" OD, T&C, Electric weld and Seamless, NEW, 8.50#
Will rent, trade or sell. Bargain.

W. C. BERRY
Ph. 3-6141 **Box 1858, Tulsa**

EQUIPMENT FOR SALE

JOY 300 Drilling Rig, butane powered, mounted on Brockaway 6x6 truck, 3500 feet 3½ inch drill pipe. Auxiliary mud pump and butane engine as separate unit. All tools and equipment included. This rig in first-class working condition and ready to go to work immediately. Call or write Steele Brothers, Crete, Nebraska. Phone 127.

OIL FIELD EQUIPMENT
10,000′ of 4½″ Casing (11 lb.) @ .80. 900′ of 7⅝″ Casing @ 1.10. 10,000′ of ¾″ Rods @ .125. 2″ Lead Line in ground. Miscellaneous Fittings. 10,000′ of 2″ Tubing @ .24. Equipment nearly new. Floyd Hubbard, Virgil, Kansas.

FOR SALE: U-15 rotary rig like new, including trailer house fully equipped. Wondeful buy. Available only because of health. Now drilling in West Texas. Inspect while in operation to get better idea. H. W. Sullivan, 611 Gulf States Bldg., Dallas 1, Tex.

EVERYTHING in new and used equipment for well drilling. Fishing tools rented. Save money, get quotations from Pressey & Son, Pueblo, Colorado.

FOR SALE: 10,000′—4½″ drill pipe, with tool joints cut off, located at Hobbs, New Mexico. Makin Drilling Company, Box 1628, Hobbs, New Mexico.

ONE WORTHINGTON 315 Skid Mounted Compressor complete for pumping natural gas. This is a two stage Compressor from 0 to 125# pressure, capacity 315 cu. ft. per minute. Used very little. For price inquire A. V. Hoenig, 1705 Philtower Building, Tulsa, Oklahoma.

WANT EQUIPMENT: Did you find the equipment you wish to purchase in this column? If not, use an "Equipment Wanted" classified advertisement to find it. It is available somewhere and Journal classified advertisements will find it. See box heading for classified rates, or write The Oil and Gas Journal.

EQUIPMENT WANTED

NOTICE: We buy. We sell equipment everywhere. If you want to sell or buy, contact Pressey & Son, Pueblo, Colorado.

WILL PAY highest prices for used casing, used line pipe, abandoned leases, or other surplus lease equipment. Your idle producing equipment is worth dollars. Green Pipe & Supply Co., Box 1383, Tulsa, Oklahoma.

EQUIPMENT NOT IN USE: Did you find a buyer in this column for the equipment you have for sale. Someone wants it and an "Equipment For Sale" classified advertisement in the Journal will find a buyer. See box heading for classified rates or write The Oil and Gas Journal.

HELP WANTED

OIL Industry Employment Service, 405 Tuloma Bldg., Tulsa, Okla. 4-5974. Tom Robinson, owner. For Technical and Trained Personnel, including LPG.

WELDING SPECIALIST

PETROLEUM REFINERY CONSTRUCTION—BRAZIL

Qualified applicant must have:
a) theoretical and practical knowledge of welding, including experience with welding of alloy steels.
b) thorough technical and practical knowledge pertaining to the welding of API & ASME code vessels and pressure piping codes.
c) experience in training and qualifying code welders.

Challenging position, excellent salary + subsistence allowance. Selected applicant's immediate family transported and returned by air at our expense.

Interviews arranged in New York City at our expense on basis of confidential resume. Airmail complete detailed chronological resume, including salary history to

PERSONNEL DEPARTMENT:

HYDROCARBON RESEARCH, INC.

115 Broadway New York 6, N. Y.

HELP WANTED

FOREIGN EMPLOYMENT. List of oil companies and drilling contractors showing where to apply for foreign jobs. OIML Co., Box 2603, Tulsa, Okla. $5.00 cash.

EXPERIENCED SEISMOLOGISTS, Party Chiefs, Seismic Computers, and Observers by major oil company. Seismologists will be permanently located in Mid-Continent Area. Applicants should have geological and/or geophysical background or at least five years' practical experience. Give full details of education and experience in letter. Reply to Box G-760, The Oil and Gas Journal, Tulsa, Oklahoma.

ADMINISTRATIVE POSITION with Major Oil Company as JR. JOB ANALYST, Dallas. Masters Degree in Chemical or Petroleum Engineering. Starting salary $4900.00 per year. Send full details to Box 2819, Dallas, Texas.

SEISMIC SUPERVISOR required by expanding and aggressive seismic contracting company. Should have ability to supervise any domestic area and have good professional contacts. Minimum requirements; college degree in geophysics or related fields and eight years' seismic experience. Good future. Tulsa location. Box G-705, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGISTS

SUBSURFACE

With degree in Geology and a minimum of 3 years' subsurface experience on deep wells. To work in Saudi Arabia on deep wells making lithologic and faunal logs from cores and cuttings, interpreting electrical logs and working on field and regional stratigraphic studies. Salary commensurate with experience and qualifications.

JUNIOR

Recent graduate with B.S. in Geology with knowledge of micropaleontology and subsurface methods. Experience desirable but not essential.

MICROPALEONTOLOGIST

Preferably with an advanced degree and a minimum of 5 years' commercial or academic experience. To work in the New York research laboratory of a major oil company. This position demands broad interests in Stratigraphy and Biofacies and the capacity to do independent work on projects assigned. Salary dependent on experience and qualifications.

Write giving personal history and work experience. Please include telephone number.

RECRUITING SUPERVISOR
BOX OGJ

Arabian-American Oil Company

505 Park Avenue
New York 22, N. Y.

HELP WANTED

ENGINEERING GRADUATE wanted for fuel testing laboratory in Southern California. CFR knocktesting experience helpful but not essential. Working and living conditions excellent. Liberal employe benefits. In reply give age, background, salary expected, etc. P. O. Box 1199, San Bernardino, California.

EXPERIENCED COMPUTER wanted by established contract company. Degree in geology or related sciences helpful, but not essential. Salary commensurate with experience and ability. All replies held in strictest confidence. Include details of experience and education. Box G-769, The Oil and Gas Journal, Tulsa, Oklahoma.

ENGINEERS, Executives, Technical Men Salaried positions—$3600 to $30,000. This confidential service for outstanding men who desire a change of connection. Will develop and conduct preliminary negotiations without risk to present position. Send name and address for details. Tomsett Associates, 434 Frick Bldg., Pittsburgh 19, Pa.

WANTED FOR EMPLOYMENT: Petroleum Engineer or Geologist with two or three years' experience in Louisina Gulf Coast. Duties will entail preparation and maintenance of detailed structure and isopach maps of south Louisina fields and evaluations necessary in field studies. Work located in New Orleans with reliable and financially strong concern. Reply giving age, experience in detail and salary desired. Inquiries will be kept strictly confidential. Our employes know of this ad. Box G-713, The Oil and Gas Journal, Tulsa, Oklahoma.

THE POSITION YOU WANT: Oil industry companies are looking for men to fill every conceivable kind of position. If you didn't find the position in this column that you are looking for, use a "Situation Wanted" classified advertisement to state your qualifications. Some company is probably looking for your ability. See box heading for classified rates or write The Oil and Gas Journal.

SITUATIONS WANTED

ATTENTION: Well established oil well drilling contractor desires to manage and supervise: Individuals', groups', small or medium-sized oil companies' drilling, production and operating problems in Central and Western Texas, and New Mexico. Personal interview by appointment is desired. Makin Drilling Company, Box No. 1628, Ph. No. 3-3141, Hobbs, New Mexico.

DRILLING AND MUD Engineer, age 37, 17 years experience, 5½ years M.E. position domestic or foreign, Canada. Interested M.E. sales contacts all M.E. companies. Box G-775, The Oil and Gas Journal, Tulsa, Oklahoma.

CHEMICAL ENGINEER: Broad refinery operating and pilot plant experience. Process engineering on refineries, petrochemical plants. Desire to relocate south-southwest. Box G-782, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM GEOLOGIST, 31, married; 5 years' varied experience in Rocky Mtns., with consultant and major company, desires position with independent company or consultant. Box G-783, The Oil and Gas Journal, Tulsa, Okla.

AIR LINE EXECUTIVE PILOT, twenty thousand hours, sixteen years air line captain, six years corporation executive pilot, excellent record, references, desires flying position. George R. Farnham, Route 2, Longview, Texas. Phone 5151.

DRLG. SUPT.: Nine years' experience, all phases drilling and well completion, Gulf Coast, offshore, Mid-Cont., Okla., Kans., Colo., Neb. & Wyo. Plus one year in South America. Dual and triple zone well completion and reservoir engineering. Have been in oil work since 1934. Graduate Petroleum Engineer. Box G-731, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST. B.S. Presently and for past two years employed by major oil company. Experience: Field studies, including subsurface mapping, cross sections, reports, etc., and as well site geologist in north and east Texas and Oklahoma. Age 31, veteran, single. Foreign employment considered. Box G-779, The Oil and Gas Journal, Tulsa, Oklahoma.

SITUATIONS WANTED

CHEMICAL ENGINEER, B.S., single, 28. Five years' refinery engineering and operating experience. Desires engineering or supervisory position. Box G-778, The Oil and Gas Journal, Tulsa, Oklahoma.

ESTABLISHED MANUFACTURERS' AGENT, graduate chemist, industrial experience. Systematically covering Texas Gulf Coast industries selling custom fabricated processing equipment, plastic products. Seek additional lines chemicals or equipment. Box G-784, The Oil and Gas Journal, Tulsa, Oklahoma.

EXPERIENCED PETROLEUM ENGINEER: 5 years Major Oil Company, desires position with Major or Independent operating in Rocky Mountain region. Box G-780, The Oil and Gas Journal, Tulsa, Oklahoma.

THE RIGHT MAN: Can you fill the position you have open from the qualifications listed in this column. Men are always looking for an opportunity to improve themselves. Use a "Help Wanted" Journal classified advertisement to find the men you need. See box heading for classified rates or write The Oil and Gas Journal.

REAL ESTATE

COMPLETELY EQUIPPED fireproof garage, 2000 sq. ft., 2 gas pumps and tanks. Plenty of outside storage with trackage. Ideal for pipe line or supply maintenance. For sale or lease. Okla. City Box 7098. Phone WI 3-4451.

ON NEW BYPASS easily accessible for heavy equipment. 3000 sq. ft. air-conditioned office space, 6 private offices. Plenty of warehouse space, open storage and parking. Adjacent to trackage. Ideal for pipe line or supply operation. Box 7098, Okla. City. Phone WI 3-4451.

SPACE IS NEEDED: A Journal display classified advertisement is the quickest way to rent or sell your real estate. In the present period of expansion oil industry firms urgently need the space you have available. If it isn't listed here, you may also find it by stating your needs in these pages. For classified rates see box heading or write The Oil and Gas Journal.

FOR SALE MAPS

DRY HOLE MAP OF OREGON, 42" x 72". DRY HOLE MAP OF WASHINGTON, 42" x 84". Price, $10.00 per map. Northwest Scouting Service, Public Service Building, Portland, Oregon.

BUSINESS OPPORTUNITIES

CAR RENTAL GAS well established; truck stop; A-1 location; 1952 sale $46,280; some motor repairs; rent $100; price $8,900. Apple Co., Brokers, Cleveland, Ohio.

RANCHES

SOUTHERN OREGON STOCK RANCH

776 Acres in Rogue River Valley. Free water for over 130 acres. Many open meadows. Balance in good stand fir and pine. Live stream. Secluded yet within easy reach of ready markets. Complete line of modern equipment, 2 sets farm buildings plus ranch headquarters. New massive early American home. Modern feed barn 650 ton capacity. Repair shop and storage for equipment. Fenced and cross-fenced. Ideal purebred operation. For full information write

VALLEY FINANCE CO.
P. O. Box 135
Grants Pass, Oregon
Price $225,000.00

FINANCING

GAS FINANCING

We finance the installation of gathering systems, compressor stations, processing plants, etc., and purchase casinghead and natural gas.

Well owners are paid for their gas and also participate in operations. Reply in confidence to

Box G-651

The Oil and Gas Journal

Tulsa, Oklahoma

ROYALTIES

WE WILL buy producing or non-producing oil royalties. Standard Security Company, 111 Broadway, New York 6, N. Y.

GET TOGETHER: Both Capital and Royalties are available. If the investment proposition you want isn't listed in this column, use a Journal classified advertisement to find it. See box heading for classified rates, or write The Oil and Gas Journal.

LEASE AND DRILLING BLOCKS

600 ACRE Lease Eastern Kentucky. One well Berea Sand excellent prospect for fracturing. Will assign one-half interest for capital to further develop. Box G-781, The Oil and Gas Journal, Tulsa, Oklahoma.

LISTS FOR SALE of leases and promotion of oil deals. Oil Industry Mailing List Co., 405 Tuloma Bldg., Tulsa, Okla.

WILL pay cash instantly for leases (large blocks), royalties, mineral deeds, production. Write fully—P. O. Box 2153, Denver, Colorado.

SEE A. L. Bowles, Rollow Building, Ada, Oklahoma, for drilling deals.

LOOKING FOR A LEASE? There will be over 40,000 wells drilled this year. If you are looking for a lease, drilling block, or drilling deal and haven't found it in this column, or if you have a lease or drilling block you want drilled, a Journal classified advertisement can find an interested party. See box heading for classified rates, or write The Oil and Gas Journal.

LEASES ROYALTIES
Producing and Nonproducing
Bought and Sold—Any Area
Inquiries Invited
B. D. BUCKLEY
6635 Delmar Ave., St. Louis 5, Mo.

ELECTRICAL CONTRACTORS

Office Phone	Res. Phone
5-5315	7-4950

W. L. RATCLIFF COMPANY
ELECTRICAL CONTRACTORS
Industrial—Commercial—Distribution

W. L. Ratcliff	508 Caddo St.
P. O. Box 373	Shreveport, La.

WILDCAT COMPLETIONS

(Continued from page 448)

NE NW NW 19-E-33. Dry. TD 1,608 ft.

McLean County: W. R. Beddingfield 1(2) Sandefur, NE NW NW 14-M-28. Dry. TD 1,885 ft.

Muhlenberg County: Basin Drilling Co. 1 Albro, SW SE SW 17-I-28. Dry. TD 1,749 ft.

MICHIGAN

Allegan County: Grand Valley Drilling Co. 2 School District, NE SE SW 1-2n-15w. Dry. TD 1,340 ft. in Traverse lime.

Lake County: Taggart Bros. Gas Co. 2 Peiser, SE SE NW 5-18n-11w. Dry. TD 1,214 ft. in Michigan Stray sand.

Van Buren County: Associated Drillers & Producers, Inc. 1 Cornish, NE NW SW 21-4s-13w. Dry. TD 1,208 ft. in Traverse lime.

WEST VIRGINIA

Webster County, Glade district: West Virginia Gas Corp. 1-575 Dewey Given, elev. 2,373 ft. Dry. Big lime, 1,903-2,120 ft., TD 2,135 ft.

Hampshire County, Gore district: M. E. Anderson 1 W. W. McBride, elev. 1,343 ft., 76,000 cu. ft., gas, Oriskany sand 5,602-5,734 ft., gas 5,636-5,639 ft., TD 6,030 ft.

GEORGIA

Wheeler County: Paul Parsons 1 Hinson, Land Lot 288, Land District 10. Dry. TD 3,614 ft. Elev. 206 ft., lower Cretaceous 3,110 ft.

ALABAMA

Baldwin County: Sunnyland Contracting Co. 1 Earle, C SW NW 5-3n-3e. Dry. TD 5,956 ft. Elev. 28 ft., lower Cretaceous 5,882 ft.

Clarke County: Pure Oil Co. 1 Scotch, S½ SW SW 11-9n-5e. Dry. TD 4,336 ft.

MISSISSIPPI

Adams County: Jett Drilling Co. and H. W. Elliott 1 Beane-Zuccaro unit, 25-6n-3w. Dry. TD 7,011 ft. Elev. 352 ft., Wilcox 4,565 ft., base Baker shale 6,416 ft., Minter zone 6,721 ft.

Franklin County: Durbin Bond & Co. 1 Combs estate, 28-6n-2e. Dry. TD 6,661 ft. Elev. 262 ft., Wilcox 4,304 ft., base Baker shale 6,100 ft., Walker 6,302 ft.

Itawamba County: Crow Well Service 1 Summers, 7-10s-9e. IP 1,700 M.c.f. daily, calculated open flow, Chester-Lewis 1,301-81 ft. TD 1,540 ft. Elev. 274 ft., Lewis lime 1,296 ft., Lewis sand 1,321 ft.

Jefferson County: Cities Service Oil Co. 1 Geoghegan, 13-8n-1e. Dry. TD 6,507 ft. Elev. 236 ft., Wilcox 3,865 ft., base Baker shale 5,677 ft.

SOUTH LOUISIANA

Ascension Parish: The Texas Co. 22 United Lands, 13-10s-4e. IP 32 BCPD and 3,154 M.c.f. daily, 20/64-in., 44.4°, casing perforations 10,248-74 ft. TD 10,754 ft. Extends, and new pay in Sorrento field.)

Beauregard Parish: Houston Oil Co. of Texas 2 Newport, C NW NW 13-5s-11w. IP 184 BOPD, 8/64-in., 42.9°, casing perforations 7,812-16 ft. TD 8,006 ft.

Cameron Parish: Humble Oil & Refining Co. 1-N Miami Corp., 32-14s-4w. Dry. TD 11,619 ft.

Rapides Parish: Union Producing Co. 8 Eota, 23-5n-3e. IPP 60 BOPD, Wilcox 5,058-61 ft. (casing perforations). TD 6,015 ft. (New field.)

St. Martin Parish: R. R. Frankel 1 Iberville, 111-7s-8e. Shutin gas well (no gage), casing perforations 10,200-06 ft. TD 10,956 ft. (New pay in Atchafalaya field.)

NORTH LOUISIANA

Bossier Parish: R. W. Fair et al 1 Keoun et al, C E½ SE NE 30-23n-12w. IPF 40 BOPD, 770 M.c.f. gas per day, Buckrange 2,872-76 ft. TD 2,900 ft. (New pay in Redland pool.)

LaSalle Parish: Hunt Oil Co. and Gulf Refining Co. 90 Louisiana Delta Lumber Co., C SW SE 17-7n-4e. Dry. TD 4,800 ft.

Hunt and Gulf 83 Louisiana Delta, C NE SE 25-5n-3e. Dry. TD 5,901 ft.

Morehouse Parish: Randerson, Scoggins and Maguire 1 Tensas Delta Lumber Co., near SWc NE NW 27-23n-4e. Dry. TD 7,116 ft.

Webster Parish: Atlantic Refining Co. 1 Miller, 1,733 ft. S and 1,266 ft. W of NEc 8-18n-1w. Dry. TD 4,960 ft.

ARKANSAS

Arkansas County: Seaboard Oil Co. "K" core test, SW SW SW SW 11-3s-4w. Dry. TD 3,918 ft.

Columbia County: Zack Brooks Drilling Co. 1 Howard estate, C SE SE NE 11-16s-22w. Dry. TD 7,439 ft.

Drew County: James W. Fair et al 1 Cavaness, near NEc 28-11s-7w. Dry. TD 4,301 ft.

Union County: J. G. Brown et al 1 Grace, C NE SE SW 33-17s-14w. Dry. TD 4,492 ft.

OKLAHOMA

Beckham County: Shell Oil Co. 1 Carter-Caughron, C SE NW 19-10n-21w. IPF 34 BOPD, 1,701 M.c.f. of gas, Des Moines 12,704-734 ft., 48.2°, 22/64-in. TD 15,624 ft. (Geological wildcat, extension, and new pay ¾ mile SW Elk City field.)

Caddo County: Mid-States 1 Hennessey, C SE SE 19-9n-11w. Dry. TD 10,431 ft.

Jefferson County: Beach & Talbot 1 Fox, SE NE SE 10-4s-4w. Dry. TD 3,015 ft.

LeFlore County: Paul Liebman 1 Lowrey, SL NE SE SW 35-7n-23e. Dry. TD 2,012 ft.

Lincoln County: Jernigan & Morgan 1 Starling, NE NE NE 8-15n-3e. IPF 25 BOPD, lower Skinner 4,333-38 ft., 39°, ⅛-in. TD 4,373 ft. (Oil discovery.)

Harper-Turner 1 Hetzel, SW SW SW 27-16n-5e. Dry. TD 4,410 ft.

Payne County: D&L Oil Co. 1 Kerns, SW SW NW 29-19n-1e. Dry. TD 5,120 ft.

Pittsburg County: C. M. Smith and Baker 1 Hewitt, NW NW NE NE 32-2n-15e. Dry. TD 300 ft.

Pontotoc County: Erle P. Halliburton 1 Bumpers, SW NE NE 3-3n-4e. Dry. TD 2,751 ft.

Stephens County: An-Son Petroleum Corp. 1 Wade, NE NW NW 14-1n-4w. Dry. TD 6,021 ft.

Tillman County: Fleet Drilling Co. 1 John, SW SW NE 2-5s-15w. Dry. TD 2,940 ft.

KANSAS

Barton County: U. S. Epperson Underwriters 1 Ochs, NW NW NE 34-16s-14w. Dry. TD 3,545 ft.

Trans Era 1 Moses, NW NW SW 27-19s-13w. Dry. TD 3,472 ft.

Cowley County: Herndon Drilling Co. 1 Devore, NW NW SW 3-33s-5e. Dry. TD 3,175 ft.

Dickinson County: Ingling 1 Gans, SE SW NE 4-12s-3e. Dry. TD 3,039 ft.

Ellsworth County: Lee Phillips 1 Janssen, SE SW SW 15-17s-9w. Dry. TD 3,300 ft.

Gove County: Wycoff Drilling Co. 1 Priefert, SE SE NE 13-13s-29w. Dry. TD 4,613 ft.

Lane County: J. S. Woodward and Co. 1 Brunner, SW SW NE 17-17s-30w. Dry. TD 4,712 ft.

Meade County: Huber Corp. 1 Adams "A," C SW NW 8-34s-29w. Dry. TD 6,110 ft., Morrow 5,788 ft.

Ness County: R. H. Siegfried et al 1 Dumler, NW NW SE 10-17s-26w. Dry. TD 4,660 ft.

Norton County: Gore 1 Snyder, NE NE NW 9-3s-23w. Dry. TD 3,575 ft.

Jones, Shelburne & Farmer 1 Gooder, NE NE NE 23-3s-24w. Dry. TD 3,720 ft.

Trans Era 1 Clark, SW SW NE 30-3s-24w. Dry. TD 3,827 ft.

Pawnee County: Murphy 1 Henson, NE NE NW 18-21s-16w. Dry. TD 3,933 ft.

Rush County: El Dorado et al 1 Pospishel, SE SE SE 2-16s-16w. Dry. TD 3,583 ft.

Northern Pump 1 Schlogel, SE SW SW 24-17s-16w. Dry. TD 3,695 ft.

Gabbert & Jones 1 Ficken, SW SW SW 1-18s-18w. Dry. TD 3,908 ft.

Russell County: Anschutz Drilling Co. 1 Roda, SE SE SE 7-12s-14w. Dry. TD 3,245 ft.

Sheridan County: Derby Oil Co. 1 Muirhead, SE SE NE 4-6s-27w. Dry. TD 3,894 ft.

Woodson County: Schroeder & Brackensciet 1 Eades, SE SE SE 7-25s-15e. Dry. TD 1,549 ft.

NEBRASKA

Cheyenne County: Plains Exploration & Dunn & Boreing 1 Hill, NE SW SW 4-15n-49w. Dry. TD 4,671 ft. "J" sand 4,654 ft.

McCourt area: Slagter Producing Co. 1 Jessen, NE NE SW 22-16n-47w. Dry. TD 4,310 ft. "J" sand 4,240 ft.

Keith County: Ohio Oil 1 Welpton, NW NW NW 27-13n-41w. Dry. TD 3,660 ft. Morrison 3,625 ft.

Kimall County: Don Rounds 1 State, SW SW NW 16-16n-54w. Dry. TD 6,000 ft. Skull Creek 5,979 ft.

McPherson County: N. B. Hunt 1 Pinkerton, SE SE SE 25-19n-33w. Dry. TD 4,374 ft. Stone Corral 3,450 ft.

SOUTH DAKOTA

Corson County: L. S. Youngblood 1 Winter, C SW SW SW 23-22n-19e. Dry. TD 5,822 ft. Lodgepole 5,720 ft.

NORTH DAKOTA

Eddy County: Calvert Exploration 1 State, C NW NW 16-150n-67w. Dry. TD 4,235 ft. pre-Cambrian 4,222 ft.

Renville County: Leach & Kelsch 1 Allen, SE SW 17-161n-84w. Dry. TD 325 ft.

Wells County: Wilson Germany-Cardinal Drilling 1 Gerhert Bohnmiller, C SE SE 26-145n-72w. Dry. TD 3,700 ft. Lodgepole 3,403 ft.

CALIFORNIA

Fresno County: Jennings & Reese 3 Chevalier, 12-21s-14e. Dry. TD 1,360 ft.

Kern County: A. M. Dunn 1-A D.L.K., SE SW 28-29s-29e, IPP 25 BOPD, 16° gravity perfs. 1,175-1,320 ft., Chanac oil sand 1,175 ft., TD 1,356 ft. (New pool discovery ½ mile northeast of Edison Groves field.)

M J M & M Oil Co. 1 Hall Community, 4-30s-29e. Dry. TD Ppramid Hills 4,910 ft., Vedder 5,025 ft., TD 5,278 ft.

Pedro Petroleum Corp. 1 Olga, 28-25s-18e. Dry. TD 795 ft.

Richfield Oil Corp. 44-10 Tejon-J, 10-11n-18w. Dry. TD 1,307 ft.

Tide Water Associated Oil Co. 24-17 Farnsworth, 17-25s-20e. Dry. TD 3,060 ft.

Madera County: Gene Reid Drilling Co. 71A-15 Arnold, 15-12s-14e. Dry. TD 6,906 ft.

Tide Water Associated Oil Co. 58-4 Redman-Cook, 4-11s-14e. Dry. TD 6,500 ft.

San Bernardino County: D. B. Lamont 1 "Well," 6-2s-7w. Dry. TD 2,400 ft.

San Luis Obispo County: Havenstrite Oil Co. 1 Havenstrite-Cleary, 8-25s-14e. Dry. TD 6,236 ft.

Santa Barbara County: Golden Bear Oil Co. 2 Dolcini, SW SW 33-10n-35w, IPP 25 BOPD, 10° gravity, perfs. 2,067-2,153 ft., TD 2,153 ft. (New field discovery in west Casmalia Hills area.)

Slick-Moorman Prod. Co. 1-C Palmer Stendel, SW NE 24-9n-33w, IPP 30 BOPD, 10° gravity, perfs. 2,331-2,780 ft., Sisquoc 1,380 ft., middle Miocene lower chert 2,390 ft., TD 3,235 ft. (New pool discovery in West Cat Canyon area.)

Richfield Oil Corp. 87-27 Heller, 27-10n-27w. TD 5,835 ft.

Ventura County: Richfield Oil Corp. 1 Scott, 1-4n-22w. Dry. TD 5,791 ft.

MONTANA

Big Horn County, Decker Prospect: Forest Oil 20-1 Erle Simpson, SW SE SE 20-9s-40e. Dry. TD 5,803 ft. Shannon 5,614 ft.

Chouteau County: Milton Spencer 1 Carpenter, NE NE SW 22-27n-7e. Dry. TD 2,773 ft. Madison 2,750 ft.

Fallon County, Webster area: Stanolind Oil & Gas 1 NPRR, C SW SE 21-4n-60e. Dry. TD 9,794 ft. Red River 9,367 ft.

Judith Basin County: W. M. Fulton 1 Sisson, SE NE SW 15-16n-10e. Shut down indefinitely. 2,045 ft. Madison 1,891 ft.

Phillips County: Chief Exploration 1 State, C NE NW 16-34n-27e. Dry. TD 4,618 ft. Mission Canyon 4,418 ft.

Teton County: L. W. Winkler 1 Sabados, SW SW NE 18-26n-6w. Temporarily abandoned. TD 2,964 ft. Madison 2,927 ft.

Gypsum Basin: K. C. Morton 1 Thorman, CN½ NW NW 4-27n-6w. Dry. TD 3,108 ft. Madison 3,107 ft.

WYOMING

Johnson County, De Smet area: G. L. Reasor 1 Tarbet, C SW NW 4-51n-53w. Dry. TD 11,041 ft. Tensleep 10,927 ft.

Weston County: A. Edmiston 1 F. E. Thompson, C SE SE 2-41n-64w. Dry. TD 6,097 ft., Newcastle 5,704 ft.

COLORADO

Adams County, West Woodrow: Denver Basin Oil Co. 1 Hough, SW SW SE 2-1s-57w. IP pumped 40 BOPD, "D" sand discovery—new field. "J" sand 5,404 ft., TD 5,587 ft.

Henderson Drilling & Harry Trueblood 1-24 Miller et al, SE SE SE 24-1s-57w. Temporarily abandoned. TD 5,493 ft. "J" sand 5,428 ft.

Vaughey & Vaughey 1 Degenhart, NW NW NW 25-2s-58w. Dry. TD 5,860 ft. "J" sand 5,750 ft.

Logan County: New Drilling Co. 1 Ada Trupp & Viola Pearl, C SW SW 13-10n-52w. Dry. TD 4,776 ft. "J" sand 4,700 ft.

Moffat County, Iles Dome area: Charles M. Jameson 1 Rader, C NE SW 17-4n-91w. Dry. TD 4,055 ft. Frontier 3,980 ft.

Morgan County: Gilliam Drilling Co. 1 Wagers, SW SW SW 12-1n-56w. Dry. TD 5,241 ft. "J" sand 5,096 ft.

Washington County: Eastern States Petroleum 1 State, C NE SE 16-3n-52w. Dry. TD 4,860 ft. "J" sand 4,704 ft.

Weld County: Shell Oil Co. 1 R. R. Biggs, C SE SW 2-11n-57w. Dry. TD 8,029 ft. Big Blue 7,936 ft.

SASKATCHEWAN

Amurex-Canada Southern 1-4 Sept., LSD 4, 1-10-29w3. Dry. TD 4,179 ft.

Socony-Sohio 1 Raymore, LSD 3, 14-27-19w2. Dry. TD 4,661 ft.

Delhi-Husky-Phillips 1 Shaunavon, LSD 13, 16-9-19w3. Dry. TD 4,950 ft.

Imperial 7-17 Smiley, LSD 7, 17-31-25w3, Viking sand oil well. TD 2,439 ft.

ALBERTA

Husky-Union-Calvan-H. B. 1 Bargrave, LSD 5, 27-30-26w4. Dry. TD 8,136 ft.

Union-E. H. Storvick 13-28, LSD 13, 28-46-17w4. Dry. TD 4,704 ft.

Socony-Seaboard 11-13 North Pembina, LSD 13, 11-49-8w5. Cardium sand oil well. 7-in. casing set at 5,062 ft. TD 5,067 ft.

Imperial 11-6 Provost, LSD 11, 6-36-2w4. Viking sand gas well. TD 2,560 ft.

Equipment Men

. . . in the News

Whitlock Elected Chairman Oil Field Haulers Conference

L. E. Whitlock, president of Whitlock Trucking Service, Stafford, Kans., was elected chairman of the Oil Field Haulers Conference of American Trucking Associations, Inc., at the A.T.A. convention recently. Whitlock succeeds L. E. Wales, president Wales Trucking Co., Dallas.

Reelected as conference officers were Chris Bunning, president John Bunning Transfer Co., Rock Springs, Wyo., named vice chairman, and Tildon L. Childs, secretary-manager Oil Field Haulers Association, Austin, Tex., named secretary.

Hammond Iron Inaugurates New Birmingham Plant

Hammond Iron Works has recently completed a modern fabricating plant on the outskirts of Birmingham, Ala. This plant, fully equipped with the latest in metal-forming and handling machinery, is designed to produce the full line of Hammond products for the oil industry of the Southeast and Central Southwest. These products include field-erected storage tanks for the petrochemical and processing industries, elevated water tanks and standpipes, and all general types of steel-plate construction.

Other Hammond plants are located in Warren and Bristol, Pa.; Provo, Utah; and Casper, Wyo.; and licensees are found in the principal foreign countries.

Christenson Reelected President, Board Chairman

Frank Christenson, of Refractory & Insulation Corp., New York, was recently reelected president and chairman of the board of the Industrial Mineral Fiber Institute, Inc., at its thirteenth annual meeting at Hot Springs, Va. As president during the last year, Christenson has guided the expansion of the industry services and activities of the associaiton representing 16 manufacturers of industrial mineral-fiber products in the United States, Canada, and abroad.

At the Hot Springs meeting, R. W. Capaul of Glass Fibers, Inc., Toledo, was named vice president, and W. M. Ehrlich, of M. H. Detrick Co., Aurora, Ill., was reappointed treasurer of the institute. Directors for the coming year are Capaul; G. J. Christner, of The Eagle-Picher Sales Co.; D. A. Rosensteele, of National Gypsum Co., and E. R. Stevens, of Baldwin-Hill Co.

Oilwell Appoints Jackson Store Manager

The appointment of E. F. Jackson as manager of the Casper, Wyo., store of United States Steel's Oilwell Supply division was announced recently by R. L. Armstrong, the division's Rocky Mountain area manager.

Jackson first entered the employ of Oilwell in 1937. He held various sales positions with Oilwell in Oklahoma and Wyoming before assuming his present duties.

Thew Shovel Co. Promotes Thibaut, Raby

The Thew Shovel Co., Lorain, Ohio, has announced the appointment of R. G. Thibaut as service manager, and C. W. Raby as assistant service manager. Thibaut succeeds R. P. Kelly, recently deceased.

Thibaut joined the firm in 1936 as assistant service manager. He previously was a field service engineer working in Thailand and other Far East countries. In his new position, Thibaut will be responsible for the servicing of Lorains in the field throughout the world.

Raby joined Thew 26 years ago, serving as traffic manager, manager of field service and now assistant service manager.

Neptune Names Haendel To District Sales Post

Neptune Meter Co., manufacturer of liquid meters, has announced the appointment of William P. Haendel, formerly in charge of petroleum and special meter sales, as district sales manager of the Chicago area. He succeeds H. B. Brown, who resigned the Chicago position due to illness, but remains on the Neptune staff. The Chicago district includes Illinois, Minnesota, Wisconsin, North and South Dakota, Michigan, and northern Indiana.

Haendel has been in the meter field for more than 30 years, including nearly 10 years in manufacturing as a plant superintendent.

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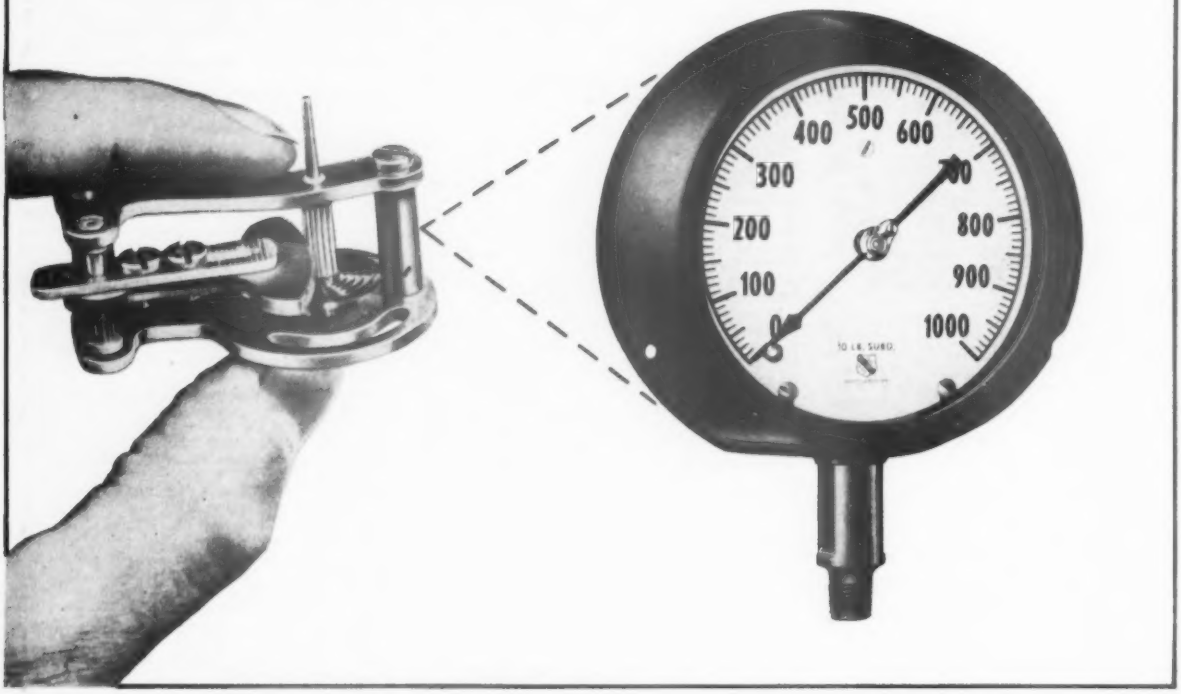

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